NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R.NAGAR, KOVILPATTI – 628 503
www.nec.edu.in

REGULATIONS – 2019

CURRICULUM & SYLLABUS

B. E. – CIVIL ENGINEERING

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CURRICULUM AND SYLLABUS

DEPARTMENT OF CIVIL ENGINEERING

VISION

Producing outstanding Civil Engineering Professionals with human values to face future challenges.

MISSION

- ➤ To provide with excellent teaching and research ambience.
- ➤ To prepare student for leadership roles in civil engineering.
- ➤ To facilitate student with lifetime skills and human values.
- ➤ To collaborate with industries to meet the ever challenging environment.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

1. Will have a successful career in civil engineering.
2. Pursue advanced degrees in support of their chosen profession.

PROGRAMMEOUTCOMES (POs)

At the time of graduation graduates of our CIVIL programme are expected to have

1. An ability to apply fundamental knowledge of mathematics, science and civil engineering in real-world problems.

2. An ability to identify, formulate and provide solution for engineering problems.

3. An ability to design and evaluate the desired needs.

4. An ability to conduct test and interpret the results.

5. An ability to use the skills, modern tools and techniques.

6. An ability to analyze the local and global impact of civil engineering.

7. Awareness of environment, innovations and sustainable development.

8. An ability to display their professional responsibilities meeting ethical standards.

9. An ability to have an idea of contemporary issues and an ability to function on multidisciplinary teams.

10. An ability to communicate effectively both in written and oral.

11. Recognition of the need for and an ability to engage in professional development and life-long learning.

12. An ability to lead a project team for the successful completion.

PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2019 are implemented based on the recommendations of AICTE, New Delhi and UGC, New Delhi. The course content of each course shall be fixed in accordance with the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs).

Further, The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates the transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **Civil Engineering programme** is designed with total number of credits *168 (125* for Lateral entry). The curriculum shall have the following category of courses with credits as given in Table - I.
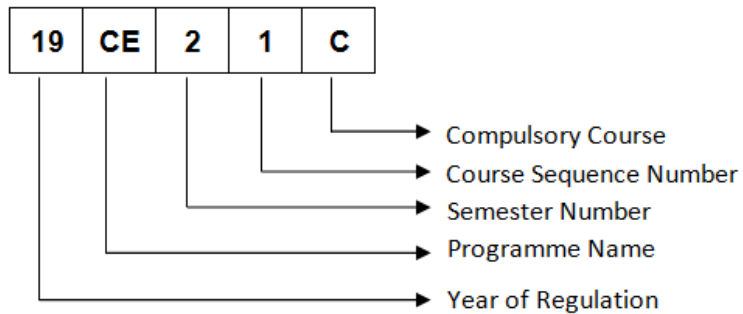
TABLE – 1   CATEGORY OF COURSES

Sl. No	Coursework – Subject Area	The range of Total credits
1.	Humanities and Social Sciences including Management courses	08
2.	Basic Science courses	21.5
3.	Engineering Science courses	22.5
4.	Programme Core courses	76
5.	Programme Elective courses relevant to chosen specialization / branch;	21
6.	Open Elective courses from other technical and /or emerging subject areas;	06
7.	Skill Development Courses	13
8.	Mandatory courses	(non – credit)
	TOTAL	**168**

i. **Humanities and Social Sciences (HSMC)** include English, Communication Skill laboratory and Management courses

ii. **Basic Science Courses**(**BSC)** include Chemistry, Physics, Biology and Mathematics

iii. **Engineering Science Courses (ESC)** include Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Civil / Computer / Instrumentation Engineering

iv. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study.

v. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective Courses (OEC)** include inter-disciplinary courses which are offered in other Engineering/Technology Programme of study.

vii. **Skill Development Courses (SDC)** include the courses such as Project, Seminar and Inplant training / Internship for improving Employability Skills.

viii. **Mandatory courses (MAC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc.

Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested, as given in Table-2.

TABLE – 2   QP – QUESTION PATTERN

R-2019 REVISED Question Pattern Format

Subject Type	Question pattern	2 marks	4 marks	10 marks	11 marks	12 marks	16 marks	20 marks	Total
Theory (3 / 4 credit)	A	10	5	-	--	5 Qns (either or type)	--	--	100
Theory (2 credit)	B	10	-	-	5 Qns (either or type)	--	--	--	75
Theory (1 credit)	C	5	--	2 Qns (either or type)	--	--	--	--	30
Theory (Trans Disciplinary)	D	-	-	-	-	-	--	5 out of 8	100
Design Oriented / Theory	E	--	-	--	-	-	--	5 Qns (either or type)	100
Theory (3 / 4 credit)	F	10	--	--	--	--	5 Qns (either or type)	--	100

FORMAT FOR COURSE CODE

19 | CE | 2 | 1 | C

- C → Compulsory Course
- 1 → Course Sequence Number
- 2 → Semester Number
- CE → Programme Name
- 19 → Year of Regulation

REGULATIONS – 2019 CURRICULUM AND SYLLABUS

B. E. – CIVIL ENGINEERING
SEMESTER – I

S. No.	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	HSMC	19SH11C	Technical English	2	0	0	2	B
2.	BSC	19SH12C	Mathematical Foundations For Engineers	3	1	0	4	A
3.	BSC	19SH13C	Engineering Physics	2	0	0	2	B
4.	BSC	19SH14C	Engineering Chemistry	2	0	0	2	B
5.	ESC	19SH15C	Engineering Graphics	2	0	4	4	E
PRACTICAL COURSES								
6.	BSC	19SH16C	Engineering Physics and Engineering Chemistry Laboratory Part A – Engineering Physics Laboratory Part B – Engineering Chemistry Laboratory	0	0	3	1.5	
7.	ESC	19SH17C	Engineering Practice Laboratory Part A – Mechanical Laboratory Part B – Electrical and Electronics Laboratory	0	0	4	2	
			TOTAL	**11**	**1**	**11**	**17.5**	

SEMESTER – II

S. No.	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1	BSC	19CE21C	Applied mathematics	3	1	0	4	A
2	BSC	19CE22C	Physics for Civil Engineering	2	0	0	2	B
3	BSC	19CE23C	Life Science	2	0	0	2	B
4	ESC	19CE24C	Problem Solving Techniques	3	0	0	3	A
5	ESC	19CE25C	Engineering Mechanics	3	1	0	4	A
6	ESC	19CE26C	Basic Electrical and Electronics Engineering	3	0	0	3	A
7	HSMC	19GN02C	Heritage of Tamils (தமிழர் மரபு)	1	0	0	1	C
PRACTICAL COURSES								
8.	ESC	19CE27C	Problem Solving Techniques Laboratory	0	0	4	2	
9.	ESC	19CE28C	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5	
10.	HSMC	19CE29C	Communication Skills laboratory	0	0	2	1	
11.	SDC	19GN01C	Innovation through Design Thinking	1	0	2	2	
			TOTAL	**18**	**2**	**11**	**25.5**	

SEMESTER – III

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	BSC	19CE31C	Transforms, Probability and Statistics	3	1	0	4	A
2.	PCC	19CE32C	Solid Mechanics	3	1	0	4	A
3.	PCC	19CE33C	Fluid Mechanics	3	0	0	3	A
4.	PCC	19CE34C	Engineering Survey– I	3	0	0	3	A
5.	PCC	19CE35C	Construction Materials, Equipment's and Practices	3	0	0	3	A
6.	ESC	19CE36C	Basic Mechanical Engineering and Energy Sciences	3	0	0	3	A
7.	HSMC	19GN03C	Tamils and Technology (தமிழரும் தொழில் நுட்பமும்)	1	0	0	1	C
PRACTICAL COURSES								
8.	PCC	19CE37C	Strength of Materials Laboratory	0	0	2	1	-
9.	PCC	19CE38C	Engineering Survey Practical–I	0	0	2	1	-
			TOTAL	19	2	4	**23**	

SEMESTER – IV

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19CE41C	Strength of Materials	3	1	0	4	A
2.	PCC	19CE42C	Applied Hydraulics and Hydraulic Machines	3	0	0	3	A
3.	PCC	19CE43C	Water Supply Treatment and Management	3	1	0	4	A
4.	PCC	19CE44C	Engineering Survey - II	3	0	0	3	A
5.	PCC	19CE45C	Soil Mechanics	3	1	0	4	A
6.	PCC	19CE46C	Concrete Technology	3	0	0	3	A
PRACTICAL COURSES								
7.	PCC	19CE47C	Engineering Survey Practical - II	0	0	2	1	-
8.	PCC	19CE48C	Hydraulic Engineering Laboratory	0	0	2	1	-
			TOTAL	18	3	4	**23**	

SEMESTER – V

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19CE51C	Basic Structural Analysis	3	1	0	4	A
2.	PCC	19CE52C	Design of Reinforced Concrete Elements	3	1	0	4	A
3.	PCC	19CE53C	Waste Water Treatment and Management	3	1	0	4	A
4.	PCC	19CE54C	Foundation Engineering	3	0	0	3	A
5.	PCC	19CE55C	Highway Engineering	3	0	0	3	A
6.	HSMC	19CE56C	Professional Ethics and Human Values	3	0	0	3	A
7.	MAC	19MC02C	CONSTITUTION OF INDIA	3	0	0	0	D
PRACTICAL COURSES								
8.	PCC	19CE57C	Concrete and Highway Engineering Laboratory	0	0	2	1	-
9.	PCC	19CE58C	Soil Mechanics Laboratory	0	0	2	1	-
			TOTAL	**21**	**3**	**4**	**23**	

SEMESTER – VI

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19CE61C	Estimation and Costing	2	1	0	3	A
2.	PCC	19CE62C	Construction Engineering and Management	3	0	0	3	A
3.	PCC	19CE63C	Solid Waste Management, Air and Noise Pollution Control	4	0	0	4	A
4.	PCC	19CE64C	Design of Steel Structures	3	0	0	3	A
5.	PEC	E1	Elective I	3	0	0	3	-
6.	PEC	E2	Elective II	3	0	0	3	-
PRACTICAL COURSES								
7.	PCC	19CE65C	Structural Design and Drawing	0	0	4	2	-
8.	PCC	19CE66C	Environmental Engineering Laboratory	0	0	2	1	-
			TOTAL	**18**	**1**	**6**	**22**	

SEMESTER – VII

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PEC	E3	Elective III	3	0	0	3	-
2.	PEC	E4	Elective IV	3	0	0	3	-
3.	PEC	E5	Elective V	3	0	0	3	-
4.	PEC	E6	Elective VI	3	0	0	3	-
5.	OEC	E7	Elective VII	3	0	0	3	-
6.	OEC	E8	Elective VIII	3	0	0	3	-
7.	HSMC	19CE71C	Project management and Finance	3	0	0	0	A
PRACTICAL COURSES								
8.	SDC	19CE72C	Project Work – I	0	0	6	3	-
9.	PCC	19CE73C	Comprehension	0	0	4	2	-
			TOTAL	21	0	10	**23**	

SEMESTER – VIII

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PEC	E9	Elective IX	3	0	0	3	-
PRACTICAL COURSES								
2.	SDC	19CE81C	Project Work – II	0	0	12	6	-
3.	SDC	19CE82C	Internship /In plant Training	0	0	4	2	-
			TOTAL	**3**	**0**	**16**	**11**	

TOTAL CREDITS TO BEEARNED FOR THE AWARD OF THE DEGREE - 168

PROGRAMME ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
STRUCTURAL ENGINEERING DOMAIN								
1.	PEC	19CE01E	Advanced Structural Analysis	3	0	0	3	A
2.	PEC	19CE02E	Bridge Structures	3	0	0	3	A
3.	PEC	19CE03E	Storage Structures	3	0	0	3	A
4.	PEC	19CE04E	Theory of plates and Shells	3	0	0	3	A
5.	PEC	19CE05E	Tall Buildings	3	0	0	3	A
6.	PEC	19CE06E	Prefabricated Structures	3	0	0	3	A
7.	PEC	19CE07E	Computer Aided Design of Structures	3	0	0	3	A
8.	PEC	19CE08E	Industrial Structures	3	0	0	3	A
9.	PEC	19CE09E	Smart Materials and Smart Structures	3	0	0	3	A
10.	PEC	19CE10E	Repair and Rehabilitation of Structures	3	0	0	3	A
11.	PEC	19CE11E	Finite Element Techniques	3	0	0	3	A
12.	PEC	19CE12E	Design of Reinforced Concrete and Brick Masonry Structures	3	0	0	3	A
13.	PEC	19CE13E	Prestressed Concrete Structures	3	0	0	3	A
14.	PEC	19CE14E	Basics of Dynamics and Aseismic Design	3	0	0	3	A
15.	PEC	19CE15E	Design of steel concrete composite structures	3	0	0	3	A
16.	PEC	19CE16E	Advanced Steel Structures	3	0	0	3	A
17.	PEC	19CE17E	Design of Shell structures	3	0	0	3	A
18.	PEC	19CE18E	Experimental Stress Analysis	3	0	0	3	A
19.	PEC	19CE19E	Non Destructive Testing	3	0	0	3	A
20.	PEC	19CE20E	Advanced Concrete Technology	3	0	0	3	A
GEOTECHNICAL ENGINEERING DOMAIN								
21.	PEC	19CE24E	Engineering Geology	3	0	0	3	A
22.	PEC	19CE25E	Rock Engineering	3	0	0	3	A
23.	PEC	19CE26E	Ground Improvement Techniques	3	0	0	3	A
24.	PEC	19CE27E	Introduction to Soil Dynamics and Machine Foundations	3	0	0	3	A
25.	PEC	19CE28E	Geotechnical Earthquake Engineering	3	0	0	3	A

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
26.	PEC	19CE29E	Earth and Earth Retaining Structures	3	0	0	3	A
27.	PEC	19CE30E	Geo Environmental Engineering	3	0	0	3	A
SURVEY AND TRANSPORTATION ENGINEERING DOMAIN								
28.	PEC	19CE31E	Remote Sensing Techniques and Geographic Information System	3	0	0	3	A
29.	PEC	19CE32E	Pavement Engineering	3	0	0	3	A
30.	PEC	19CE33E	Traffic Engineering and Management	3	0	0	3	A
31.	PEC	19CE34E	Railways, Airports and Harbour Engineering	3	0	0	3	A
32.	PEC	19CE35E	Advanced Surveying	3	0	0	3	A
33.	PEC	19CE36E	Highway Traffic Analysis and Design	3	0	0	3	A
34.	PEC	19CE37E	Transportation Planning	3	0	0	3	A
35.	PEC	19CE70E	Intelligent Transportation Systems	3	0	0	3	A
36.	PEC	19CE71E	Road Transport Management and Economics	3	0	0	3	A
ENVIRONMENTAL ENGINEERING DOMAIN								
37.	PEC	19CE38E	Environmental Impact Assessment	3	0	0	3	A
38.	PEC	19CE39E	Industrial Waste Management	3	0	0	3	A
39.	PEC	19CE40E	Ecological Engineering	3	0	0	3	A
40.	PEC	19CE41E	Environmental Instrumentation	3	0	0	3	A
41.	PEC	19CE42E	Soil Pollution Engineering	3	0	0	3	A
42.	PEC	19CE43E	Climate Change Adaptation and Mitigation	3	0	0	3	A
43.	PEC	19CE44E	Hazardous Waste Management	3	0	0	3	A
44.	PEC	19CE75E	Environmental Biotechnology	3	0	0	3	A
IRRIGATION AND WATER RESOURCES ENGINEERING DOMAIN								
45.	PEC	19CE45E	Hydrology	3	0	0	3	A
46.	PEC	19CE46E	Ground Water Engineering	3	0	0	3	A
47.	PEC	19CE47E	Coastal Zone Management	3	0	0	3	A
48.	PEC	19CE48E	Water Resources Engineering	3	0	0	3	A
49.	PEC	19CE49E	Irrigation Engineering	3	0	0	3	A
50.	PEC	19CE50E	Integrated Water Resources	3	0	0	3	A

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
			Management					
51.	PEC	19CE51E	Water Quality Modelling	3	0	0	3	A
CIVIL ENGINEERING MANAGEMENT DOMAIN								
52.	PEC	19CE52E	Housing Planning and Management	3	0	0	3	A
53.	PEC	19CE53E	Architecture and Town Planning	3	0	0	3	A
54.	PEC	19CE54E	Total Quality Management	3	0	0	3	A
55.	PEC	19CE55E	Engineering Economics and Cost Analysis	3	0	0	3	A
56.	PEC	19CE56E	Intellectual Property Rights (IPR)	3	0	0	3	A
57.	PEC	19CE57E	Management of Irrigation Systems	3	0	0	3	A
58.	PEC	19CE58E	Product Development Laboratory	1	0	2	2	-
59.	PEC	19CE59E	Construction Management and Safety	3	0	0	3	A
60.	PEC	19CE60E	Safety in Civil Engineering Practices	3	0	0	3	A
REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM DOMAIN								
61.	PEC	19CE61E	Remote Sensing and GIS for Engineering Applications	3	0	0	3	A
62.	PEC	19CE62E	UAV Photogrammetry	4	0	0	4	A
63.	PEC	19CE63E	Total Station and GPS Surveying	4	0	0	4	A
64.	PEC	19CE64E	Terrestrial, Mobile and Aerial LIDAR	3	0	0	3	A
65.	PEC	19CE65E	UAV Photogrammetry Laboratory	0	1	3	2	-
66.	PEC	19CE66E	Total Station and GPS Surveying Laboratory	0	1	3	2	-

ONE CREDIT ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
STRUCTURAL ENGINEERING DOMAIN								
1.	*PEC*	19CE01L	Recent Advancements in Special Concrete	1	0	0	1	C
2.	*PEC*	19CE02L	Design of Foundation Elements	1	0	0	1	C
3.	*PEC*	19CE03L	Earth Retaining Structures	1	0	0	1	C
4.	*PEC*	19CE04L	Traffic Engineering and safety	1	0	0	1	C

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
5.	*PEC*	19CE05L	Bridge construction techniques	1	0	0	1	C
6.	*PEC*	19CE06L	Decentralized Waste WaterTreatment System (DEWATS)	1	0	0	1	C
7.	*PEC*	19CE07L	Building marking	1	0	0	1	C
8.	*PEC*	19CE08L	Introduction to Geographic Information System (GIS)	1	0	0	1	C
9.	*PEC*	19CE09L	Timber structures	1	0	0	1	C
10.	*PEC*	19CE10L	Earthquake Resistant Design	1	0	0	1	C
11.	*PEC*	19CE11L	Seismic evaluation and retrofitting of structures	1	0	0	1	C
12.	*PEC*	19CE12L	Tunneling Techniques	1	0	0	1	C
13.	*PEC*	19CE13L	Soil contamination and remediation	1	0	0	1	C
14.	*PEC*	19CE14L	Environmental noise Pollution	1	0	0	1	C
15.	*PEC*	19CE15L	Safety In Construction	1	0	0	1	C
16.	*PEC*	19CE16L	Design of Industrial Roofing System	1	0	0	1	C
17.	*PEC*	19CE17L	Advanced Engineering Materials in Construction	1	0	0	1	C
18.	*PEC*	19CE18L	Environmental Clearance (EC)	1	0	0	1	C
19.	*PEC*	19CE19L	Environmental Legislations	1	0	0	1	C
20.	*PEC*	19CE20L	Environmental Engineering Drawing	1	0	0	1	C
21.	*PEC*	19CE21L	Analytical Instrumentation	1	0	0	1	C
22.	*PEC*	19CE22L	Coating Technology	1	0	0	1	C
23.	*PEC*	19CE23L	Acoustics	1	0	0	1	C
24.	*PEC*	19CE24L	Computer Aided Building Layout Drawing	0	0	2	1	-
25.	*PEC*	19CE25L	C Programming applications for Civil Engineering-I	0	0	2	1	-
26.	*PEC*	19CE26L	C Programming applications for Civil Engineering-II	0	0	2	1	-
27.	*PEC*	19CE27L	C Programming applications for Civil Engineering-III	0	0	2	1	-

LIST OF VERTICALS

Vertical I (Structures)	Vertical II (Geotechnical)	Vertical III (Transportation)	Vertical IV (Environmental)	Vertical V (Water Resource)	Vertical VI (Civil Engg. Management)	Vertical VII (Remote sensing & GIS)	Vertical VIII (Diversified Course)
Advanced Concrete Technology	Engineering Geology	Railways, Airports and Harbour Engineering	Industrial Waste Management	Water Resources Engineering	Architecture and Town Planning	Advanced Surveying	Smart Materials and Smart Structures
Finite Element Techniques	Rock Engineering	Traffic Engineering and Management	Environmental Instrumentation	Ground Water Engineering	**Construction Management and Safety**	Remote Sensing and GIS for Engineering Applications	Tall Buildings
Computer Aided Design of Structures	**Earth and Earth Retaining Structures**	**Transportation Planning**	**Soil Pollution Engineering**	Hydrology	Housing Planning and Management	UAV Photogrammetry	Experimental Stress Analysis
Advanced Structural Analysis	Ground Improvement Techniques	Pavement Engineering	**Climate Change Adaptation and Mitigation**	Irrigation Engineering	Total Quality Management	Total Station and GPS Surveying	Non Destructive Testing
Design of steel concrete composite structures	**Geo environmental Engineering**	**Highway Traffic Analysis and Design**	**Hazardous Waste Management**	Coastal Zone Management	Intellectual Property Rights (IPR)	Terrestrial, Mobile and Aerial LIDAR	Remote Sensing Techniques and Geographic Information System
Advanced Steel Structures	Introduction to Soil Dynamics and Machine Foundations	**Road Transport Management and Economics**	**Environmental Biotechnology**	**Integrated Water Resources Management**	Engineering Economics and Cost Analysis	UAV Photogrammetry Laboratory	Ecological Engineering
Basics of Dynamics and Aseismic Design	Earthquake Geotechnical Engineering	**Intelligent Transportation Systems**	Environmental Impact Assessment	**Water Quality Modelling**	Management of Irrigation Systems	Total Station and GPS Surveying Laboratory	**Safety in Civil Engineering Practices**

VERTICAL I: STRUCTURES

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE01E	Advanced Structural Analysis	3	0	0	3	A
2.	PEC	19CE07E	Computer Aided Design of Structures	3	0	0	3	A
3.	PEC	19CE11E	Finite Element Techniques	3	0	0	3	A
4.	PEC	19CE14E	Basics of Dynamics and Aseismic Design	3	0	0	3	A
5.	PEC	19CE15E	Design of steel concrete composite structures	3	0	0	3	A
6.	PEC	19CE16E	Advanced Steel Structures	3	0	0	3	A
7.	PEC	19CE20E	Advanced Concrete Technology	3	0	0	3	A

VERTICAL II: GEOTECHNICAL

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE24E	Engineering Geology	3	0	0	3	A
2.	PEC	19CE25E	Rock Engineering	3	0	0	3	A
3.	PEC	19CE26E	Ground Improvement Techniques	3	0	0	3	A
4.	PEC	19CE27E	Introduction to Soil Dynamics and Machine Foundations	3	0	0	3	A
5.	PEC	19CE28E	Earthquake Geotechnical Engineering	3	0	0	3	A
6.	PEC	19CE29E	Earth and Earth Retaining Structures	3	0	0	3	A
7.	PEC	19CE30E	Geo Environmental Engineering	3	0	0	3	A

VERTICAL III : TRANSPORTATION

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE32E	Pavement Engineering	3	0	0	3	A
2.	PEC	19CE33E	Traffic Engineering and Management	3	0	0	3	A
3.	PEC	19CE34E	Railways, Airports and Harbour Engineering	3	0	0	3	A
4.	PEC	19CE36E	Highway Traffic Analysis and Design	3	0	0	3	A

5.	PEC	19CE37E	Transportation Planning	3	0	0	3	A
6.	PEC	19CE70E	Intelligent Transportation Systems	3	0	0	3	A
7.	PEC	19CE71E	Road Transport Management and Economics	3	0	0	3	A

VERTICAL IV : ENVIRONMENTAL

S.No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE38E	Environmental Impact Assessment	3	0	0	3	A
2.	PEC	19CE39E	Industrial Waste Management	3	0	0	3	A
3.	PEC	19CE41E	Environmental Instrumentation	3	0	0	3	A
4.	PEC	19CE42E	Soil Pollution Engineering	3	0	0	3	A
5.	PEC	19CE43E	Climate Change Adaptation and Mitigation	3	0	0	3	A
6.	PEC	19CE44E	Hazardous Waste Management	3	0	0	3	A
7.	PEC	19CE75E	Environmental Biotechnology	3	0	0	3	A

VERTICAL V : WATER RESOURCE

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE45E	Hydrology	3	0	0	3	A
2.	PEC	19CE46E	Ground Water Engineering	3	0	0	3	A
3.	PEC	19CE47E	Coastal Zone Management	3	0	0	3	A
4.	PEC	19CE48E	Water Resources Engineering	3	0	0	3	A
5.	PEC	19CE49E	Irrigation Engineering	3	0	0	3	A
6.	PEC	19CE50E	Integrated Water Resources Management	3	0	0	3	A
7.	PEC	19CE51E	Water Quality Modelling	3	0	0	3	A

VERTICAL VI: CIVIL ENGINEERING MANAGEMENT

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE52E	Housing Planning and Management	3	0	0	3	A

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
2.	PEC	19CE53E	Architecture and Town Planning	3	0	0	3	A
3.	PEC	19CE54E	Total Quality Management	3	0	0	3	A
4.	PEC	19CE55E	Engineering Economics and Cost Analysis	3	0	0	3	A
5.	PEC	19CE56E	Intellectual Property Rights (IPR)	3	0	0	3	A
6.	PEC	19CE57E	Management of Irrigation Systems	3	0	0	3	A
7.	PEC	19CE59E	Construction Management and Safety	3	0	0	3	A

VERTICAL VII: REMOTE SENSING & GIS

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE35E	Advanced Surveying	3	0	0	3	A
2.	PEC	19CE61E	Remote Sensing and GIS for Engineering Applications	3	0	0	3	A
3.	PEC	19CE62E	UAV Photogrammetry	4	0	0	4	A
4.	PEC	19CE63E	Total Station and GPS Surveying	4	0	0	4	A
5.	PEC	19CE64E	Terrestrial, Mobile and Aerial LIDAR	3	0	0	3	A
6.	PEC	19CE65E	UAV Photogrammetry Laboratory	0	1	3	2	-
7.	PEC	19CE66E	Total Station and GPS Surveying Laboratory	0	1	3	2	-

VERTICAL VIII : DIVERSIFIED COURSE

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern
1.	PEC	19CE05E	Tall Buildings	3	0	0	3	A
2.	PEC	19CE09E	Smart Materials and Smart Structures	3	0	0	3	A
3.	PEC	19CE18E	Experimental Stress Analysis	3	0	0	3	A
4.	PEC	19CE19E	Non Destructive Testing	3	0	0	3	A
5.	PEC	19CE31E	Remote Sensing Techniques and Geographic Information System	3	0	0	3	A
6.	PEC	19CE40E	Ecological Engineering	3	0	0	3	A
7.	PEC	19CE60E	Safety in Civil Engineering Practices	3	0	0	3	A

Open Elective Course (OEC)

Group – I (Inter-disciplinary courses)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	19ID01E	Product Design and Development	3	0	0	3	E
2.	OEC	19ID02E	Disaster Management	3	0	0	3	E
3.	OEC	19ID03E	Energy Engineering	3	0	0	3	E
4.	OEC	--	Other Programme Courses	3	0	0	3	As specified for the Chosen Course

Group-II (Trans-disciplinary courses) - Self Study Course

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	19TD01E	Soft Skills and Interpersonal Communication	0	0	0	3	D
2.	OEC	19TD02E	Impact of social media on society	0	0	0	3	D
3.	OEC	19TD03E	International Business Management	0	0	0	3	D
4.	OEC	19TD04E	Basics of Marketing	0	0	0	3	D
5.	OEC	19TD05E	Indian Economy	0	0	0	3	D
6.	OEC	19TD06E	International Trade	0	0	0	3	D
7.	OEC	19TD07E	Global Challenges and issues	0	0	0	3	D
8.	OEC	19TD08E	Indian Culture and Heritage	0	0	0	3	D
9.	OEC	19TD09E	Indian History	0	0	0	3	D
10.	OEC	19TD10E	Sustainable Development and Practices	0	0	0	3	D
11.	OEC	19TD11E	Women in Indian Society	0	0	0	3	D
12.	OEC	19TD12E	Bio Mechanics in Sports	0	0	0	3	D

19SH11C   **TECHNICAL ENGLISH**   **L T P C**
                    (Common to all B.E. / B.Tech. Degree Programmes)   **2 0 0 2**

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

   CO1: apply the basic language skills to understand various aspects of communication skills (K3)
   CO2: express their thoughts with correct usage of language in formal writings (K3)
   CO3: understand various language components and develop the pronunciation skill. (K2)
   CO4: make effective technical writings and interpret any pictorial representation. (K3)
   CO5: frame sentences and write effective reports. (K3)

UNIT I   **6**
Parts of Speech – Word formation using Prefixes and Suffixes - Informal writing - Diary writing, Letter to Friend / Parent / Siblings - Greetings and Self Introduction – Situational Phrases - Tense (Present)

UNIT II   **6**
Technical terms and extended definitions - Transformation of words into different grammatical forms – Tense (Past) –Letter writing (for Industrial visit and training) - Instruction Writing - Listening for general information.

UNIT III   **6**
Personality Adjectives - Phonetics (Vowels - Consonants– Diphthongs - Transcriptions) – Kinds of Sentences (Statement, Interrogative, Imperative & Exclamatory) – Situational Conversation.

UNIT IV   **6**
Commonly Misspelled words – Active and Passive Voices – E - mail writing - Picture Description – Checklists

UNIT V   **6**
Homophones - Concord - Tense (Future) - Foreign Words and Phrases - Report writing (Types – Structure - Stages in Report writing- Model Report) – Reading Comprehension.

Suggested Activity: Book Review – Herein the students will be required to submit a review of a book (Literary or non-literary) of their choice. This will be followed by a presentation of the same in the class.

                                                      L: 30; TOTAL: 30 PERIODS

TEXT BOOKS
   1. Anderson, Paul V. "Technical Communication: A Reader - Centered Approach", 9th Edition, Cengage, New Delhi, 2018.
   2. Jan Svartvik, et.al. "A Comprehensive Grammar of the English Language", Longman Inc., Newyork, 2014.

REFERENCES
1. Murphy Raymond, "Basic Grammar Practice on Tense", Cambridge University Press: New Delhi, 2018.
2. Kumar, Suresh. E., "Engineering English", Orient Blackswan, Hyderabad, 2015.

19SH12C   **MATHEMATICAL FOUNDATIONS FOR ENGINEERS**   **L T P C**
                  (Common to all B.E. / B.Tech. Degree Programmes)   **3 1 0 4**

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: make use of orthogonal transformation. (K3)
   CO2: find the evolutes of various curves.(K2)
   CO3: maxima and minima of real valued functions.(K3)
   CO4: solve ordinary differential equations.(K2)
   CO5: solve partial differential equations.(K2)

UNIT I   MATRICES   12
Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof)

UNIT II   DIFFERENTIAL CALCULUS   12
Curvature in cartesian, parametric and polar forms – Centre of curvature, radius of curvature and circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

UNIT III   FUNCTIONS OF SEVERAL VARIABLES   12
Partial derivative – Total derivative – Euler's theorem on homogeneous functions – Taylor's Series – Jacobians – Maxima and Minima – Constrained Maxima and Minima by the method of Lagrange's multipliers.

UNIT IV   ORDINARY DIFFERENTIAL EQUATIONS   12
Solutions of first order ordinary differential equations - Equations solvable for 'p', equations solvable for 'y', equations solvable for 'x' - Solutions of higher order linear differential equations with constant coefficients – Cauchy's and Legendre's linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation.

UNIT V   PARTIAL DIFFERENTIAL EQUATIONS   12
Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange's linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficients.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2014.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Private Limited, 2017.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.

19SH13C	ENGINEERING PHYSICS	L T P C
	(Common to all B.E. / B.Tech. Degree Programmes)	2 0 0 2

COURSE OUTCOMES

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

CO1: summarize the properties and structures of crystal solids. (K2)

CO2: understand the principle and propagation of different types of waves (K2)

CO3: choose the appropriate Laser technique for industrial and medical applications (K2)

CO4: describe the different types, fabrication, losses of optical fibers and their applications in communication and instrumentation. (K2)

CO5: explain the physical properties of photons & electrons and their applications in different electron microscopes. (K2)

UNIT I   CRYSTALLOGRAPHY   6

Lattice, Unit cell, Bravais lattice, Lattice planes - Crystal system - Miller indices – d spacing - Characteristics of SC, BCC, FCC and HCP structures- Crystal defects.

UNIT II   WAVES   6

Simple harmonic oscillators - Damped harmonic oscillator - Forced mechanical and electrical oscillators - Transverse wave on a string - Wave equation on a string - Longitudinal waves and wave equation - Acoustics waves

UNIT III   LASER   6

Principle of spontaneous emission and stimulated emission, Population inversion, Pumping, Einstein's A and B coefficients – Different types of lasers: gas lasers (CO_2), solid-state lasers (Nd-YAG) - Applications of lasers in science, engineering and medicine.

UNIT IV   FIBRE OPTICS   6

Principle – Total internal reflection - Acceptance angle and Numerical aperture - Types of optical fibers - Double crucible technique – Splicing - Losses in optical fibers - Fiber optic communication system - Applications - Fiber optic sensors – Medical Endoscope.

UNIT V   QUANTUM PHYSICS   6

Black Body Radiation - Matter Waves - Heisenberg's uncertainty principle - Schrodinger's wave equation - Particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 11th Edition, John Wiley & Sons Inc.USA, 2018.
2. Arthur Beiser, "Concepts of Modern Physics", 7th Edition, Mc-Graw Hill Publications Private Limited, 2017.
3. D. J. Griffiths, "Quantum mechanics", 2nd Edition, Cambridge University Press, 2014.

REFERENCES

1. Renk, Karl.F "Basics of laser physics", 2nd Edition, Springer international publishing, 2017.
2. H. J. Pain,Patricia Rankin "Introduction to vibration and waves", 1st Edition, Wiley, 2015
3. K.S.Mathur, "Fundamentals of Fiber Optics",1st Edition, Zorba books, 2018.

19SH14C	ENGINEERING CHEMISTRY	L T P C
	(Common to all B.E. / B.Tech. Degree Programmes)	2 0 0 2

COURSE OUTCOMES

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

CO1: identify the various water treatment technique for domestic and industrial purpose. (K2)

CO2: understand the various isotherms, kinetics in surface chemistry and catalysis. (K2)

CO3: acquire the knowledge of electrochemistry and corrosion and its control. (K2)

CO4: familiar with the various novel organic material used in electronics industry. (K2)

CO5: understand the principle, components and working of various analytical instruments. (K2)

UNIT I   WATER TREATMENT   6

Hardness - Estimation of hardness of water – Specifications for drinking water (BIS and WHO standards) - Softening of water: External and Internal treatments of water – Desalination - Methods of treatment of municipal water - Waste water treatments: primary, secondary and tertiary

UNIT II   SURFACE CHEMISTRY AND CATALYSIS   6

Adsorption – Types - Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – Kinetics of surface reactions - Unimolecular reactions - Applications of adsorption on pollution abatement.

Catalysis: Catalyst – Types of catalysis – Criteria – Autocatalysis – Acid base catalysis – applications - Catalytic convertor – Enzyme catalysis – Michaelis – Menten equation.

UNIT III   ELECTROCHEMISTRY AND CORROSION   6

Electrode potential-Nernst Equation-reference electrode - glass electrode - measurement of pH – electrochemical series – significance – Conductometric titrations (strong acid vs strong base and weak acid vs strong base)

Corrosion: Types of corrosion - Factors influencing corrosion – Corrosion control – Sacrificial anode and impressed current cathodic methods – Corrosion inhibitors

UNIT IV   ELECTRONIC MATERIALS   6

Organic semiconducting materials: advantages- p-type and n-type semiconducting materials – pentacene – fullerens-C-60; organic light emitting polymer: polyvinylidene fluoride - OLED material – polyphenylene vinylene - micro and nano sensors - fundamentals of sensors, biosensor - chemical sensors

UNIT V   ANALYTICAL TECHNIQUES   6

Spectroscopy:Principle, instrumentation and applications of UV-Visible and IR spectroscopy. chromatography: - HPLC (Principle, instrumentation and applications of HPLC and gas chromatography - Flame photometry – Estimation of sodium and potassium by Flame photometry.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, New Delhi, 2016.
2. S.S Dara and S.S Umare, A Text Book of Engineering Chemistry, S.Chand & Company Limited, 20th Edition, 2018.

REFERENCES

1. P. Brezonik, W. Arnold, Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems, Oxford Press, 6th Edition, 2017.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal, Principles of Physical Chemistry, Vishal Publishing Co., Punjab, 47th Edition, 2017.
3. S. Crouch, D. Skoog, F Holler, Principles of Instrumental Analysis Hardcover, 2017.
4. H. Klauk, "Organic Electronics: Materials, manufacturing and applications", Wiley - VCH, 2016

19SH15C	ENGINEERING GRAPHICS	L T P C
	(Common to all B.E. / B.Tech. Degree Programmes)	2 0 4 4

COURSE OUTCOMES

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

CO1: familiarize with the fundamentals of Engineering graphics and construct the engineering curves. (K2)

CO2: construct the orthographic projections of points, straight lines and lamina (K2)

CO3: draw the projections of simple solids in different positions. (K3)

CO4: visualize the sectional views and surface areas of various solids. (K3)

CO5: perform freehand sketching and prepare elementary 2-D and 3D sketches of simple solids. (K3)

INTRODUCTION **5**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise. First angle projection should be followed for all the topics except projection of points.

UNIT I **ENGINEERING CURVES** **17**

Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids - construction of involutes for square and circle –Tangent and Normal to the above curves.

UNIT II **ORTHOGRAPHIC PROJECTIONS** **17**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

UNIT III **PROJECTIONS OF SOLIDS** **17**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

UNIT IV **SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES** **17**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section.
Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

UNIT V **ISOMETRIC PROJECTIONS AND FREE HAND SKETCHING** **17**

Principles of isometric projection – isometric scale – isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids. Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

L: 30; P: 60; TOTAL: 90 PERIODS

TEXT BOOKS
  1. Bhatt N.D, "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.
  2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2nd Edition, 2009.

REFERENCES
  1. Agrawal B. & Agrawal C.M., Engineering Graphics, TMH Publication, 2nd Edition, 2013
  2. Narayana K.L. & Kannaiah P, Text book on Engineering Drawing, Scitech Publishers, 2010.
  3. Gopalakrishna K.R, "Engineering Drawing", Subhas Publications, 32nd Edition, 2017.

19SH16C	ENGINEERING PHYSICS AND ENGINEERING CHEMISTRY LABORATORY	L T P C
		0 0 3 1.5

(Common to all B.E. / B.Tech. Degree Programmes)

PART A – ENGINEERING PHYSICS LABORATORY

COURSE OUTCOMES

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

CO1: demonstrate the different phenomenon exhibited by the waves. (K2)

CO2: interpret the production of ultrasounds and the variation of velocity of ultrasounds with respect to different medium.(K2)

CO3: illustrate the electrical properties of materials. (K2)

LIST OF EXPERIMENTS

1. Determination of thickness of a thin wire – Air wedge method.
2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of angle of divergence of laser beam and acceptance angle, numerical aperture of optical fibre.
5. Determination of acceleration due to gravity using compound pendulum.
6. Determination of (a) spring Constant (b) Value of g and (c) Modulus of Rigidity of a spring by studying motion of a spring.
7. Determination of specific resistance of the coil using Carey-Foster's bridge.

- A minimum of FIVE experiments shall be offered.

REFERENCES

1. David Loyal, " Physics laboratory" 4th Edition, Cengage learning, 2013
2. Sesha Sai Kumar Vemula, "Engineering Physics lab manual" 1st Edition, LAP LAMBERT Academic Publishing, 2017

PART B - ENGINEERING CHEMISTRY LABORATORY

COURSE OUTCOMES

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

CO 1: determine various water quality parameters. (K2)

CO 2: quantify different ions by different analytical techniques. (K2)

CO3: determine the rate of corrosion of mild steel plate. (K2)

CO4: verify the freundlich adsorption isotherm. (K2)

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method.
2. Estimation of iron (Fe^{2+}) by dichrometric method.
3. Determination of rate of corrosion of mild steel plate by weight loss method.
4. Estimation of hydrochloric acid by conductometric method.
5. Estimation of mixture of acids by conductometric method.

6. Determination of purity of simple organic compounds using HPLC- (Demo).
7. Estimation of iron (Fe^{2+}) by spectrophotometric method.
8. Verification of Freundlich adsorption isotherm by using oxalic acid in activated charcoal.

P: 45; TOTAL: 45 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. D.C. Harris "Quantitative Chemical Analysis: International Edition", W.H.Freeman, 9th Edition, 2016.
2. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford , P.W.G.Smith, Vogel's Textbook of Practical Organic Chemistry, Pearson Education Limited, England, 8th Edition, 2015.
3. M. Nath, Inorganic Chemistry: A Laboratory Manual, Alpha Science, New Delhi, 2016.

19SH17C	ENGINEERING PRACTICE LABORATORY	L T P C
	(Common to all B.E. / B.Tech. Degree Programmes)	0 0 4 2

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

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

CO1: prepare different carpentry joints. (K3)
CO2: prepare pipe connections with different joints for domestic applications. (K3)
CO3: make simple components using sheet metal (K3)
CO4: make components using machining operations (K3)
CO5: explain the types of welding processes (K2)
CO6: discuss the applications of 3D printing and injection moulding processes (K2)

LIST OF EXPERIMENTS

I. CARPENTRY PRACTICES 5

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands on exercise with application

II. PLUMBING PRACTICES 5

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands on exercise with application

III. SHEET METAL PRACTICES 5

1. Forming and Bending
2. Model making: Tray, Conical Funnel etc.

IV. MACHINING PRACTICES   **5**
1. Simple Turning
2. Drilling Practice
3. Model making: Shaft, stiffener plate, square flange, etc.
4. Demonstration of machining process in Vertical Machining Centre (VMC)

V. METAL JOINING PROCESS   **5**
1. Demonstration of Gas, Arc and TIG Welding

**VI. ADDITIVE MANUFACTURING AND INJECTION MOULDING
    PROCESSES**   **5**
1. Demonstration of 3D Scanning and Printing
2. Demonstration of Injection Moulding process

P: 30; TOTAL: 30 PERIODS

TEXT BOOK
1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007

REFERENCES
1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kannaiah P and Narayana KL, "Manual on Workshop Practice", Scitech Publications, 1999.

PART B – ELECTRICAL AND ELECTRONICS LABORATORY

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: perform residential house wiring (K2)
   CO2: identify faults in any electrical appliances (K2)
   CO3: measure energy and resistance to earth of electrical equipment (K2)
   CO4: measure AC signal parameters using CRO (K2)
   CO5: apply soldering for electronic circuit formation in PCB (K2)

LIST OF EXPERIMENTS

ELECTRICAL
1. Residential House Wiring using Switches, Fuse, Indicator, Lamp and Energy Meter.
2. Stair Case Wiring Connections
3. Measurement of Energy using Energy Meter for Single Phase System.
4. Measurement of Earth Resistance using Electrical Equipment.

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5. Study of Emergency Lamp, Choke, Starter, Fan and Iron Box
6. Coil Rewinding for Transformer and Fan using Rewinding Machine.
7. Connection of protective devices

ELECTRONICS

8. Study of Resistor, capacitor and inductor
9. Study and Operation of Digital Multimeter, Function/Signal Generator and Regulated Power Supply.
10. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency) using CRO and DSO.
11. Soldering Practice
12. Study of logic gates AND, OR, NOT, NAND, NOR and EXOR.
13. Half Wave Rectifier and Full Wave Rectifier.

P: 30; TOTAL: 30PERIODS

REFERENCES

1. Jeyachandran K, Natarajan S and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Pvt. Ltd, 2006.
3. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L., "Manual on Workshop Practice", Scitech Publications, 1999.

19CE21C　　　　　　　　　**APPLIED MATHEMATICS**　　　　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 1 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
　　CO1: calculate the Fourier series solution of Wave and Heat equations. (K3)
　　CO2: evaluate area and volume using double and triple integrals. (K3)
　　CO3: analyze the concepts related to vector calculus. (K3)
　　CO4: grasp Analytic functions and their properties. (K2)
　　CO5: evaluate complex integration over contour.(K3)

UNIT I　　　　BOUNDARY VALUE PROBLEMS　　　　　　　　　　　　12
Fundamentals of Fourier series - Half range sine and cosine series, Parseval's theorem - Fourier series solutions of one dimensional wave equation - One dimensional heat equation - Steady state solution of two dimensional heat equation.

UNIT II　　　　INTEGRAL CALCULUS　　　　　　　　　　　　　　　12
Evaluation of double and triple integrals- Change of order of integration - Change of variables - Cartesian to polar coordinates- Area and volume - Beta and Gamma integrals - Definite integrals in terms of Beta and Gamma functions.

UNIT III   VECTOR CALCULUS   12

Gradient, Divergence and Curl –Directional derivatives – Irrotational and solenoidal vector fields -Vector integration–Line, Surface and Volume Integrals –Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem–Simple applications involving cubes and rectangular parallelopipeds.

UNIT IV   ANALYTIC FUNCTIONS   12

Analytic functions - Necessary and Sufficient conditions - Harmonic and orthogonal properties of analytic functions - Harmonic conjugate - Construction of analytic functions - Conformal mapping: w= z+c, cz, 1/z and bilinear transformation.

UNIT V   COMPLEX INTEGRATION   12

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's expansions - Singular points - Residues - Residue theorem - application of residue theorem to evaluate real integrals - unit circle and semi-circular contour

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

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

REFERENCES

1. Bali NP and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications (P) Ltd., 9th Edition, 2017.
2. Ramana BV, "Higher Engineering Mathematics", Tata McGraw Hill Publishing company, 6th Edition, New Delhi, 2008.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publishing House Private Limited, 5th Edition, 2016.

19CE22C   PHYSICS FOR CIVIL ENGINEERING   L T P C
2 0 0 2

COURSE OUTCOMES

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

CO 1: understand the basics of mechanics and principle of turbines. (K2)
CO 2: summarize the working principles of vacuum pumps and gauges.(K2)
CO 3: express the acoustic properties of buildings. (K2)
CO 4: gain knowledge on various lighting designs for buildings and colours. (K2)
CO 5: explain the properties and performance of advanced materials. (K2)

UNIT I   MECHANICS   6

Newton's laws – force, momentum and impulse – Work and Energy equations and applications - Turbines – working principle and applications.

UNIT II   PUMPS AND GAUGES   6

Vacuum pumps – Working principle – Rotary pumps and diffusion pumps - Centrifugal pumps and reciprocating pumps - Vacuum gauges - Working principle – Pirani gauge and penning gauge - Manometer.

UNIT III   ACOUSTICS   6

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

UNIT IV   LIGHTING DESIGNS   6

Radiation quantities – spectral quantities – relationship between luminescence and radiant quantities – hemispherical reflectance and transmittance – Photometry: Cosines law, Inverse square law - Colour theory.

UNIT V   ADVANCED ENGINEERING MATERIALS   6

Nano phase materials - Shape memory alloys - Metallic glasses – Fibre reinforce plastics - Advanced ceramics materials - MEMS.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS
1. Daniel Kleppner and Robert Kolankow, "An Introduction to Mechanics", Tata McGraw-Hill Pubishing Company, 1st Edition, 2017.
2. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2015
3. Stevens, W.R., "Building Physics: Lighting: Seeing in the Artificial Environment, Pergaman Press, 2013

REFERENCES
1. Gaur R.K. and Gupta S.L., "Engineering Physics" Dhanpat Rai publishers, 2012
2. Patti Mollica, "Color Theory: An essential guide to color-from basic principles to practical applications" Walter Foster Publishers, 2013
3. Dr. RK Bansal "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Revised 9th Edition, 2010.

19CE23C   LIFE SCIENCE   L T P C
**   2 0 0 2**

COURSE OUTCOMES
Upon completion of this course, the students will be able to
  CO1: describe and comprehend the fundamental concepts of cell biology. (K2)
  CO2: understand the components and functions of ecosystem. (K2)
  CO3: familiar with the importance and toxicity of some transition elements in biological systems. (K2)
  CO4: describe the various types of bioremediation process. (K2)
  CO5: recognize the various environmental monitors and waste treatment techniques. (K2)

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UNIT I   CELL BIOLOGY   6
Cell as a basic unit of life-Cell organization of prokaryotic and eukaryotic cells-Structural and functional capitalization of cell: Mitochondria, Chloroplast, Lysosomes, Golgi bodies, Plasma membrane, Cytoskeleton, Cell wall and Nucleus - Cell cycle - cell division: mitosis and meiosis.

UNIT II   ECOLOGY   6
Ecosystems: Components, types, flow of matter and energy in an ecosystem- Community ecology: Characteristics, frequency, life forms, and biological spectrum- Ecosystem structure: Biotic and abiotic factors, food chain, food web and ecological pyramids.

UNIT III   METALS IN BIOLOGICAL SYSTEMS   6
Introduction - Importance of Mg, Mn, Fe, Co, Ni, Cu and Zn in biological systems - Metal toxicity.

UNIT IV   BIOREMEDIATION   6
Introduction - Advantages and applications -Types of bioremediation-Natural (attenuation)- Ex-situ and In-situ.

UNIT V   ENVIRONMENTAL MONITORING AND WASTE TREATMENT   6
Introduction – Bio-indicators - Biomarkers - Biosensors-Biotechnological processes – Waste treatment – Equalization – Neutralization - Removal of suspended and dissolved organic solids - Chemical oxidation, Adsorption – Removal of dissolved inorganic solids.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS
1**.** A.K.Chatterji, Introduction to Environmental biotechnology, PHI Learning Private Limited, New Delhi, 2011.
2. R.M Maier, I.L. Pepper and C.P.Gerba, Environmental Microbiology, Academic Press, 2000.

REFERENCES
1. G.Karp, Cell and Molecular Biology: Concepts and Experiments, John Wiley, 6th Edition, 2009.
2. Dieter Rehder, Bioinorganic Chemistry, Oxford University Press, 1st Edition, 2014.
3. S. Manahan, Environmental Chemistry, CRC Press, 10th Edition, 2017.

19CE24C	PROBLEM SOLVING TECHNIQUES	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO 1: develop algorithmic solutions to simple computational problems. (K3)
   CO 2: make appropriate decisions and solve problems using looping techniques.(K2)
   CO 3: solve problems using array and functions. (K3)
   CO 4: implement various sorting techniques. (K3)
   CO 5: implement various searching techniques. (K3)

UNIT I   BASICS OF PROBLEM SOLVING   9

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Difficulties in problem solving, Program design, implementation issues, programming environment, Data Storage and Communication with Computer, Organizing the Problem. Algorithms for problem solving: Algorithms and flow charts, flowchart symbols, design of algorithms for simple and scientific problems, divide and conquer strategy.

UNIT II   BASIC TECHNIQUES   9

Sequential Logic Structure, Decision Making, Looping Techniques, Multi-Way decision Making, Solving With Modules.

UNIT III   ARRAYS AND FUNCTIONS   9

Arrays: one dimensional array – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

UNIT IV   SORTING TECHNIQUES   9

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Postman Sort, Quick Sort, Merge Sort, Radix Sort, Applications

UNIT V   SEARCHING TECHNIQUES   9

Searching algorithms: Linear search, Binary search, Fibonacci search, Golden-ratio selection, Golden section search method, Applications

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Maureen Sprankle and Jim Hubbard, "Problem Solving and Programming Concepts", Prentice Hall, 9th Edition, 2012.
2. Harsha Priya, R. Ranjeet, — Programming and Problem Solving Through C Language, Firewall / Laxmi Publications (P) Ltd., New Delhi, 2015.

REFERENCES

1. Pradip Dey, Manas Ghosh, Fundamentals of Computing and Programming in C, 2nd Edition, Oxford University Press, 2013.
2. M.G.Venkateshmurthy, Programming Techniques through C: A Beginner's Companion, Pearson Education, Canada, 2009.
3. Ashok.N.Kamthane, Computer Programming, Pearson Education, India, 2011.

19CE25C   ENGINEERING MECHANICS   L T P C
**   3 1 0 4**

COURSE OUTCOMES

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

CO1: use the basic concept of force systems and solve problems. (K2)

CO2: implement the knowledge acquired in supports, reactions, equilibrium of rigid bodies for solving problems. (K2)

CO3: predict centre of gravity, moment and product moment of inertia of simple configurations. (K2)

CO4: solve practical problems on Projectiles, Newton"s laws, work-energy, impulse momentum and impact on elastic bodies. (K2)

CO5: apply the principles of friction and rigid body dynamics to analyze and solve problems (K2)

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force – Vectorial representation of forces.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram - Types of supports and their reactions – requirements of 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 – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes– First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula - second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem. Principal moment 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 principal – relation to area moments of bodies.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Projectile motion – Newton"s law – Work Energy Equation of particles – Impulse and Momentum. Definition – time of compression, restitution, collision – laws of conservation of momentum – coefficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – loss of kinetic energy.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Frictional force – Laws of Coulomb friction – Simple contact friction – Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Beer, F.P. and Johnson Jr. E.R., "Vector Mechanics for Engineers", Vol.1 Statics and Vol.2 Dynamics, McGraw Hill International, 9th Edition, 2010.
2. Vela Murali, "Engineering Mechanics" Oxford University, 2010.

REFERENCES

1. Rajasekaran S and Sankarasubramanian G, "Fundamentals of Engineering Mechanics", Vikas Publishing House Private Limited, 3rd Edition, 2010.
2. Hibbeller R.C., "Engineering Mechanics", Vol.1 Statics, Vol.2 Dynamics, 12th Edition, Pearson Education Asia Private Limited, 2010.
3. Irving H Shames, "Engineering Mechanics – Statics and Dynamics", Pearson Education Asia Private Limited, 4th Edition, 2009.

19CE26C   BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain the concepts of basic electrical circuits (K2)
CO2: describe the working principles of electrical machines and instruments (K2)
CO3: outline the functions of the component of low voltage electrical installations (K2)
CO4: explain the characteristics and applications of semiconductor devices (K2)
CO5: recall the different logic principles used in digital circuits(K2)

UNIT I   CONCEPTS OF DC AND AC ELECTRICAL CIRCUITS   9
Electrical Circuit Elements – Ideal and Practical Sources – Electrical Quantities: Voltage, Current, Power and Energy – Ohms Law – Kirchoffs Laws – analysis of simple circuit with DC excitation- AC Circuits Fundamentals – Single Phase Circuits and Three Phase Circuits – Power and Power Factor.

UNIT II   ELECTRICAL MACHINES   9
DC Machines: Types – Construction – Working Principles – Need for Starters - Speed control of DC motors.
AC Motors: Construction and Working of Single Phase and Three Phase Induction Motor – Starting and Speed Control of Induction Motors.
AC Synchronous Generators: Construction – Working Principle.
Transformers: Single Phase and Three Phase Transformers – Auto Transformers - Construction – Working Principle.

UNIT III   INSTRUMENTS AND ELECTRICAL INSTALLATION   9
Instruments: Functional Elements – Principles of Measurements of Electrical Quantities: Voltage, Current, Power and Energy – Multifunction meter.
Electrical Installation: Components of LT Switchgear – Switch Fuse – MCB – ELCB – MCCB – Types of Wires and Cables – Earthing – Energy Storage devices - Elementary Calculations for Energy Consumptions and Battery Backup.

UNIT IV   SEMICONDUCTOR DEVICES AND APPLICATIONS   9
Operation, Characteristics and Applications: PN Junction Diode - Rectifiers - Zener Diode – Regulators - Bipolar Junction Transistor –CE Amplifier - FET – Opto-Electronic Devices – LEDs – Photo Diodes.

UNIT V DIGITAL ELECTRONICS 9

Binary Number System – Logic Gates – Boolean Algebra – Adders - Flip Flops– Shift Registers – Counters – ADC and DAC.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. D.P. Kothari and I.J. Kothari, "Basic Electrical and Electronics Engineering", 1st Edition, Tata McGraw Hill, 2014.
2. P.S. Bimbhra, "Electrical Machinery", Khanna Publishes, 7th Edition, 2011.
3. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, New Delhi, 2009.
4. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2004.

REFERENCES

1. D.C. Kulshreshtha, "Basic Electrical Engineering", Revised 1st Edition, Tata McGraw Hill, 2011.
2. L.S.Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
3. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
4. V.D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
5. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill, 2003.
6. David Bell, "Electronic Devices and Circuits", Prentice Hall Private Limited, 2007.
7. M. Morris Mano, "Digital Design", 4th Edition, Pearson Education, 2007.

19GN02C	HERITAGE OF TAMILS (தமிழர் மரபு)	LT P C
		1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

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

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

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

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV   THINAI CONCEPT OF TAMILS   3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V   CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND
          INDIAN CULTURE   3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**19GN02C   HERITAGE OF TAMILS (தமிழர் மரபு)   LT P C
                                                                    1 0 0 1**

அலகு I   மொழி மற்றும் இலக்கியம்   3

இந்திய மொழிக்குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க

இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II   மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை   3
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III   நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்   3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV   தமிழர்களின் திணைக் கோட்பாடுகள்   3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு V   இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின்
                பங்களிப்பு   3**
இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

19CE27C   PROBLEM SOLVING TECHNIQUES LABORATORY   L T P C
                                                               0 0 4 2

COURSE OUTCOMES
Upon completion of this course, the students will be able to
  CO 1: solve simple and Complex problems. (K3)
  CO 2: solve sorting and searching problems. (K3)

LIST OF EXERCISES
Programs using simple logics and switch cases
1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Find the roots of a quadratic equation
3. Design a simple arithmetic calculator. (Use switch statement)
4. Design a traffic light controller (Use switch statement)

Programs using Control Structures
5. Perform the following operations:
       a. Generate Pascal's triangle.
       b. Construct a Pyramid of numbers.
6. Generate of the first n terms of the Fibonacci sequence and prime sequence.
7. Compute Sine series and Cosine series.
8. Find the 2's complement of a binary number.
Programs using Arrays
9. Perform the following operations:
       a. Matrix addition.
       b. Transpose of a matrix.
       c. Matrix multiplication by checking compatibility

Programs to manipulate Strings
10. Perform the following operations on a string:
      a. Insert a sub-string into main string at a given position.
      b. Delete n characters from a given position in a string.

c. Check whether the given string is palindrome or not.

d. Replace a character of string either from beginning or ending or at a specified location.

Programs using Functions

11. Perform the following operations: (Use recursive functions)
    a. Find the factorial of a given integer.
    b. Find the GCD (Greatest Common Divisor) of two given integers.
    c. Solve the Towers of Hanoi problem.

Programs using sorting and searching techniques

12. Implement Insertion Sort, Merge Sort
13. Implement Linear search, Binary search

P: 60; TOTAL: 60 PERIODS

Software Requirement: Turbo C / Python

19CE28C	BASIC ELECTRICAL AND ELECTRONICS	L T P C
	ENGINEERING LABORATORY	0 0 3 1.5

COURSE OUTCOMES

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

   CO1: demonstrate the common components with different rating and use the instruments   (K2)

   CO2: analyze the basic electrical circuits (K2)

   CO3: infer the characteristics of electrical machines (K2)

   CO4: demonstrate the functionality and characteristics of electronics devices. (K2)

LIST OF EXPERIMENTS

1. Basic Safety Precautions, Practical Circuit Elements and Measuring Instruments – Voltmeter, Ammeter, Wattmeter and Energy Meter
2. Verification of Ohms Law and Kirchoff Laws
3. Load test of Single Phase Transformer
4. Load test on DC Shunt Motor
5. Load test on DC Series Motor
6. Load test on Single Phase Induction Motor
7. Load test on Three Phase Induction Motor
8. Experimental Verification of PN Junction diode Characteristics.
9. Experimental Verification of Zener Diode Characteristics and Zener Diode as Voltage Regulator
10. Input and Output Characteristics of BJT in CE Configuration
11. Truth Tables and Functionality of Flip Flops

P: 45; TOTAL: 45 PERIODS

19CE29C	**COMMUNICATION SKILLS LABORATORY**	**L T P C**
	(Common to all B.E. / B.Tech., Degree Programmes)	**0 0 2 1**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO 1: Listen and respond effectively to interact at different situations fluently (K2)

CO2: Excel appropriately in professional contexts. (K3)

CO3: Acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace. (K3)

UNIT I   **10**

Lab session: Listening and responding to audio files

Practice session: Mini Presentation related to Business English & Picture description.

UNIT II   **10**

Lab session: Role Play – News Reader

Practice session: Resume Preparation

UNIT III   **10**

Lab session: Listening to audio files related to soft skills.

Practice session: Practicing Power point presentation, Group discussion.

P: 30; TOTAL: 30 PERIODS

REFERENCES

1. Dutt P. Kiranmai and Rajeevan Geeta, "Basic Communication Skills", Foundation Books, 2013.
2. Comfort, Jeremy, et al. "Speaking Effectively, Developing Speaking Skills for Business English", Cambridge University Press, Cambridge: Reprint 2011.
3. Rizvi.M.Ashraf, "Effective Technical Communication", The MC-Graw Hill Education Private Limited, Companies, New Delhi, 2010.

19GN01C	INNOVATION THROUGH DESIGN THINKING	L T P C
		1 0 2 2

COURSE OUTCOMES

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

CO1: To discuss the design thinking process and innovation. (K2)

CO2: Practice design thinking process through a multidisciplinary task. (K3)

UNIT I	BASICS OF DESIGN THINKING PROCESS	15

Design thinking process basics-Ideation tools-case studies.

UNIT II	PRACTICING DESIGN THINKING PROCESS	30

Real world problem selection-Practicing the preliminary stages of Design Thinking Process - work presentation.

L: 15; P: 30; TOTAL: 45 PERIODS

REFERENCES

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020
3. D.M. Arvind Mallik, "Design Thinking for Educators", Notion Press, 2019
4. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
5. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company, 2019
6. Robert Curedale, "Design Thinking Process & Methods" 5th Edition, Design Community College Inc, 2019
7. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
8. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
9. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", 2nd Edition, Zaccheus Entertainment, 2017
10. Scott Swan, Michael G. Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
11. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2009

MENTOR ACTIVITIES:

Educating the design thinking process: basics, Ideation tools and 10 Hours empathy map through case studies - presentation

Forming multidisciplinary batches among the students- Guide the 20 Hours batches to select a real-world task- Apply and practice the different stages of Design thinking process to bring out innovative solutions

Evaluating the students' activities through their presentations

End semester Assessments can be made through:

- Design Thinking presentation(PowerPoint format)
- Design Thinking poster preparation and presentation (PDF format, in color and monochrome, printable in A3 size)

Other points:

This course is for all department students
- A class/section should be with all department students
- A course instructor will be responsible for the academic process.
- In a project batch, maximum number of students should be four and no two students from same discipline possibly.
- The course has no pre-requisite and may be offered to second/fourth semester students.

19CE31C   TRANSFORMS, PROBABILITY AND STATISTICS   L T P C
                                                          3 1 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to
- CO1: compute the Fourier transforms of various functions. (K2)
- CO2: apply Laplace Transform techniques to solve ordinary differential equations. (K2)
- CO3: solve difference equations using Z–Transforms. (K2)
- CO4: grasp basic probability concepts and standard distributions. (K2)
- CO5: calculate the various measures of dispersion and testing of Hypothesis. (K3)

UNIT I   FOURIER TRANSFORM   12

Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II   LAPLACE TRANSFORM   12

Existence conditions -– Transforms of elementary functions – Properties – Transforms of periodic functions – Initial and final value theorems – Convolution theorem - Inverse transforms - Transform of Derivatives and Integrals - Solutions of linear ordinary differential equations of second order with constant coefficients.

UNIT III   Z – TRANSFORM   12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solutions of difference equations using Z-transform.

UNIT IV   RANDOM VARIABLES   12

Discrete and continuous random variables – Moments -Moment generating function and their properties.Binomial, Poisson, Uniform, Exponential and Normal distributions.

UNIT V   STATISTICS   12

Mean, median, mode and standard deviation - Sampling distributions - Tests for single mean, Proportion, Difference of means (for large samples) – Tests for single variance and equality of variances – t-test, F-Test and Chi-square test for goodness of fit – Independence of attributes.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. Grewal.B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2011.

REFERENCES
1. OliverC.Ibe, "Fundamentals of Applied Probability and Random processes", Elsevier, First Indian Reprint, 2007.
2. Peebles Jr.P.Z., "Probability R and om Variables and Random Signal Principles", 4th Edition, Tata McGraw-Hill Publishers, New Delhi, 2002.
3. Bali N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publishing House Private Limited, 2016.

19CE32C	SOLID MECHANICS	L T P C
		3 1 0 4

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

    CO1: identify the basic properties of solids. (K3)
    CO2: analyze the plane truss. (K3)
    CO3: analyze the transverse loading on beams (K3)
    CO4: calculate the deflection in beams and shear stresses (K3)
    CO5: determine Torsion in shafts and springs (K3)

UNIT I   STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS   12

Rigid bodies and deformable solids – Stability, strength, stiffness – Tension, compression and shear stresses – Strain, elasticity, Hooke's law, limit of proportionality, modulus of elasticity, stress -strain curve, lateral strain – Temperature stresses – Deformation of simple and compound bars – Shear modulus, bulk modulus, relationship between elastic constants – Biaxial state of stress – Stress at a point – Stress on inclined plane – Principal stresses and principal planes – Mohr's circle of stresses.

UNIT II   ANALYSIS OF PLANE TRUSS   12

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss member's method of joints, method of sections, method of tension coefficients – Graphical Method.

UNIT III   TRANSVERSE LOADING ON BEAMS   12

Beams – Types of supports – Simple and fixed, types of load – Concentrated, uniformly distributed, varying distributed load, combination of above loading – Relationship between bending moment and shear force – Bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Theory of simple bending-Bending stress.

UNIT IV   DEFLECTION OF BEAMS AND SHEAR STRESS   12

Deflection of beams – Double integration method – Macaulay's method – Slope and deflection using moment area method, Conjugate Beam method – Variation of shear stress – Shear stress distribution in rectangular, I sections, solid circular sections, hollow circular sections, angle and channel sections.

UNIT V   TORSION AND SPRINGS   12

Stresses and deformation in circular (solid and hollow shafts) – Stepped shafts – Shafts fixed at both ends – Leaf springs – Stresses in helical springs – Deflection of springs**.**

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2015.
2. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 6th Edition, 2018.

REFERENCES
1. Timoshenko.S.B. and Gere.J.M, "Mechanics of Materials", Van Nos Reinbhold, New Delhi 1999.
2. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited, New Delhi, 2009.
3. Rattan. S.S, "Strength of Materials", Tata McGraw Hill Education Private Limited, New Delhi, 2012
4. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS–I Strength materials, Laxmi publications, New Delhi, 2015
5. Srinath, L.S. "Advanced mechanics and solids", Tata-McGraw Hill Publishing Company Limited, 3rd Edition 2009.

19CE33C	**FLUID MECHANICS**	**L T P C**
		3 0 0 3

COURSE OUTCOMES

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

   CO1: illustrate the basic fluid properties. (K2)
   CO2: estimate the pressure, hydrostatic forces and concepts of continuity equation acting in the fluid (K3)
   CO3: extend the knowledge of Bernoulli"s equation and the condition of flow in a circular pipe. (K3)
   CO4: enumerate the concepts of boundary layer and losses computed in a pipe flow (K2)
   CO5: paraphrase the idea of dimensional and model analysis with other model / prototype problems. (K2)

UNIT I   DEFINITIONS AND FLUID PROPERTIES   7

Definitions – Fluid and fluid mechanics – Dimensions and units – Fluid properties – Continuum Concept of system and control volume.

UNIT II   FLUID STATICS AND KINEMATICS   10

Pascal's Law and Hydrostatic equation – Forces on plane and curved surfaces – Buoyancy – Meta centre – Pressure measurement –Fluid Kinematics -Stream, streak and path lines – Classification of flows – Continuity equation (one, two and three dimensional forms) – Stream and potential functions – flow nets – Velocity measurement (Pitot tube, current meter, Hot wire and hot film anemometer, float technique, Laser Doppler velocimetry).

UNIT III   FLUID DYNAMICS   10

Euler and Bernoulli's equations – Application of Bernoulli's equation – Discharge measurement – Laminar flows through pipes and between plates – Hagen Poiseuille equation – Turbulent flow – Darcy – Weisbach formula – Moody diagram – Momentum Principle.

UNIT IV   BOUNDARY LAYER AND FLOW THROUGH PIPES   9

Definition of boundary layer – Thickness and classification – Displacement and momentum thickness– Development of laminar and turbulent flows in circular pipes – Major and minor losses of flow in pipes – Pipes in series and in parallel – Pipe network.

UNIT V   SIMILITUDE AND MODEL STUDY   9

Dimensional Analysis – Rayleigh's method, Buckingham's Pi-theorem – Similitude and models studies – Scale effect and distorted models.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Jain.A.K.., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, 12th Edition, 2016.
2. Modi, P.N. & Seth, S.M "Hydraulics and fluid Mechanics", Standard book house, New Delhi, 2015.

REFERENCES
1. Streeter, Victor, L. and Wylie, Benjamin E., "Fluid Mechanics", McGraw-Hill Limited, 1998.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2013.
3. Subramanya.K "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

19CE34C   **ENGINEERING SURVEY- I**   **L T P C**
                                                             3 0 0 3

COURSE OUTCOMES
Upon successful completion of this course, the students will be able to
   CO1: explain the basic principle of chain surveying. (K2)
   CO2: interpret the working principle of compass and plane table surveying. (K2)
   CO3: demonstrate the application of leveling in the field surveying. (K2)
   CO4: demonstrate the application of theodolite in the field surveying. (K2)

CO5: outline engineering surveys and usage of modern surveying instruments. (K2)

UNIT I   INTRODUCTION AND CHAIN SURVEYING   9
Definition - Principles - Classification - Field and office work - Scales - Conventional signs - Survey instruments, their care and adjustment - Ranging and chaining - Reciprocal ranging - Setting perpendiculars - well conditioned triangles - Traversing - Plotting - Enlarging and reducing figures.

UNIT II   COMPASS SURVEYING AND PLANE TABLE SURVEYING   9
Prismatic compass – Surveyor's compass - Bearing - Systems and conversions - Local attraction - Magnetic declination - Dip - Traversing - Plotting - Adjustment of errors - Plane table instruments and accessories - Merits and demerits - Methods - Radiation - Intersection - Resection - Traversing.

UNIT III   LEVELLING AND APPLICATIONS   9
Level line - Horizontal line - Levels and Staves - Spirit level - Sensitiveness - Bench marks - Temporary and permanent adjustments - Fly and check levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Longitudinal and cross sections - Plotting - Calculation of areas and volumes - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs.

UNIT IV   THEODOLITE SURVEYING   9
Theodolite - Vernier and microptic - Description and uses - Temporary and permanent adjustments of vernier transit - Horizontal angles - Vertical angles - Heights and distances - Traversing - Closing error and distribution - Gale"s tables - Omitted measurements.

UNIT V   ENGINEERING SURVEYS AND MODERN INSTRUMENTS   9
Reconnaissance, preliminary and location surveys for engineering projects - Lay out - Setting out works - Route Surveys for highways, railways and waterways - Mine Surveying - instruments - Tunnels - Correlation of underground and surface surveys - Shafts – Adits - Electromagnetic distance measurement - Carrier waves - Principles – Instruments –Total Station –GPS.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I ,Lakshmi Publications Private Limited, New Delhi, 2005
2. Kanetkar T.P., "Surveying and Levelling", Vols.I, United Book Corporation, Pune, 2006.

REFERENCES
1. Clark D., "Plane and Geodetic Surveying", Vols. I, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2004.
2. James M.Anderson and Edward M.Mikhail, "Introduction to Surveying", McGraw-Hill Book Company, 7th Edition 2012.
3. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.

19CE35C   CONSTRUCTION MATERIALS, EQUIPMENT'S AND PRACTICES

L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: describe the Primary Construction materials and their properties. (K2)
CO2: describe the Secondary Construction materials and their properties. (K2)
CO3: illustrate the Construction Practices. (K2)
CO4: identify the Construction techniques. (K3)
CO5: utilize the construction equipments. (K3)

UNIT I   PRIMARY CONSTRUCTION MATERIALS   9

Stones – Types – characteristics – uses - BIS tests - Tiles-types, selection, suitability, uses and maintenance – Bricks – composition – manufacture – types - BIS tests. Hollow concrete blocks, Burnt clay hollow Blocks, Stabilized mud blocks – Selection of Building Blocks – Cement – Manufacturing – Different types - hydration- setting and hardening – Initial & Final Setting Time-Cement mortar.

UNIT II   SECONDARY CONSTRUCTION MATERIALS   9

Timber- defects-causes of decay - seasoning – preservation - fire proofing - Laminated wood products - types – properties – uses of fiber boards, particle boards, hard boards and A.C boards - Paints – types – wall paints – wood paints – metal paints. Steel Properties – types- Aluminum products - UPVC – crack fillers – Asbestos –GI Sheets– Glass – water proofing compounds – fiber reinforced plastic – smart concrete and smart bricks.

UNIT III   CONSTRUCTION PRACTICES   9

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry – concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements– temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames .

UNIT IV   SPECIAL FORMS OF CONSTRUCTION   9

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - driving diaphragm walls, sheet piles - shoring for deep cutting - well points - Dewatering and stand by Plant equipment for underground open excavation. Launching girders, bridge decks, off shore platforms.

UNIT V   CONSTRUCTION EQUIPMENT   9

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

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. S.C. Rangawala, "Engineering materials", Charotar Publishing House, New Delhi, 2014.
2. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 2010.

REFERENCES

1. Santhakumar. A.R, "Conrete Technology", Oxford University Press, 2007.
2. P.C Varghese "Building Materials", PHI Learning Private Limited, 2nd Edition, 2015.
3. Neville A.M., "Properties of Concrete", Pearson Education, 2008

19CE36C   BASIC MECHANICAL ENGINEERING AND ENERGY SCIENCES

L T P C
3 0 0 3

COURSE OUTCOMES

Upon successful completion of the course the students will be able to

CO1: describe the thermodynamic systems and apply first law of thermodynamics to various systems. (K2)

CO2: explain second law of thermodynamics and study the feasibility of a process based on first and second law of thermodynamics. (K2)

CO3: determine the change in properties of atmospheric air subjected to psychrometric processes (K3)

CO4: familiarize with the basic concepts of various forms of renewable energy sources. (K2)

CO5: realize the present energy scenario and the need for energy conservation and various energy conservation measures. (K2)

UNIT I   BASICS AND FIRST LAW OF THERMODYNAMICS   9

Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics - concept of temperature and heat.Concept of ideal and real gases.First Law of Thermodynamics-Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady - Flow Engineering Devices.

UNIT II   SECOND LAW OF THERMODYNAMICS   9

Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy.

UNIT III   PSYCHROMETRY   9

Psychrometry and psychrometric charts, Dalton's law of partial pressure - property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing - evaporative cooling.

UNIT IV   ALTERNATIVE ENERGY SOURCES   9

Introduction to energy systems and resources, sustainability & the environment. Fossil fuels - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, wave, tidal and hydrogen energy; possibilities for energy storage or regeneration - Pumped storage hydro power.

UNIT V   ENERGY CONSERVATION   9

Energy efficiency and conservation; Introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, Concept of Green Buildings and Green Architecture; LEED ratings; Embodied energy analysis. Energy Audit of Facilities and optimization of energy consumption.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Yunus A Cengel and Michael A Boles, "Thermodynamics - An Engineering Approach", 7th Edition Tata McGraw-Hill Education, 2014.
2. Boyle, Godfrey, "Renewable Energy", 3rd Edition, Oxford University Press, 2012.

REFERENCES
1. Nag PK, "Engineering Thermodynamics", 5th Edition, the Mc-Graw Hill Book Company, 2013.
2. Sonntag, Borgnakke and Van Wylen, "Fundamentals of Thermodynamics", 1st Edition, Wiley India Private Limited, 2010.
3. Holman JP, "Thermodynamics", McGraw-Hill Education, 1988.
4. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.), "Energy Systems and Sustainability: Power for a Sustainable Future", Oxford University Press, 2004.
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., "Energy and the Environment", 2nd Edition, John Wiley, 2006.

19GN03C   TAMILS AND TECHNOLOGY (தமிழரும் தொழில்நுட்பமும்)   LT P C
                                                                        1 0 0 1

UNIT I   WEAVING AND CERAMIC TECHNOLOGY   3

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

UNIT II   DESIGN AND CONSTRUCTION TECHNOLOGY   3

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

UNIT III   MANUFACTURING TECHNOLOGY   3

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

UNIT IV   AGRICULTURE AND IRRIGATION TECHNOLOGY   3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V   SCIENTIFIC TAMIL & TAMIL COMPUTING   3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

L: 15; TOTAL : 15 PERIODS

REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

19GN03C   TAMILS AND TECHNOLOGY (தமிழரும் தொழில்நுட்பமும்)   LT P C
1 0 0 1

அலகு I   நெசவு மற்றும் பானைத் தொழில்நுட்பம்   3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II   வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்   3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை.

அலகு III   உற்பத்தித் தொழில்நுட்பம்   3

கப்பல் கட்டும் கலை — உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எ∴கு — வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV   வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்   3

அணை, ஏரி, குளங்கள், மதகு — சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு — கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு — மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு — அறிவுசார் சமூகம்.

அலகு V   அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்   3

அறிவியல் தமிழின் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி — தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

19CE37C **STRENGTH OF MATERIALS LABORATORY** **L T P C**
0 0 2 1

COURSE OUTCOMES
Upon Successful completion of this course, the students will able to
   CO1: demonstrate the fundamental modes of loading the structures (K2)
   CO2: perform experiments making measurements of loads, displacements and Strains (K3)
   CO3: compute the strength of the material and stiffness properties of Structural elements (K3)

LIST OF EXPERIMENTS
1. Test involving axial compression on concrete cylinder to obtain the stress – strain curve
2. Test involving axial tension to obtain the stress – strain curve and the strength
3. Test involving torsion to obtain modulus of rigidity value of the specimen
4. Test involving flexure to obtain the load deflection curve and hence the stiffness
5. Tests on springs
6. Test to verify Maxwell's reciprocal theorem
7. Test on wooden specimen (Compression, Tension and shear)
8. Hardness tests
9. Shear test
10. Test for impact resistance

The student should learn the use of deflectometer, extensometer, compressometer and strain gauges.

LIST OF EQUIPMENTS
(For a batch of 30 students)

Sl. No.	Description of Equipments	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine for steel rods	1
3.	Izod impact testing machine	1
4.	Hardness test	

	Rockwell	1 each
	Vicker's	
	Brinnel	
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9.	CompressionTesting Machine (100 Ton)	1

P: 30; TOTAL 30 PERIODS

19CE38C   ENGINEERING SURVEY PRACTICAL - I   L T P C
0 0 2 1

COURSE OUTCOMES

Upon Successful completion of this course, the student will able to

CO1: Experiment with chain, compass and plane table surveying (K2)
CO2: Perform leveling and tachometry survey in the field.(K3)

LIST OF EXPERIMENTS

1. Study of chains and its accessories
2. Aligning, Ranging and Chaining
3. Chain Traversing
4. Compass Traversing
5. Plane table surveying: Radiation
6. Plane table surveying: Intersection
7. Plane table surveying: Resection – Three point problem
8. Plane table surveying: Resection – Two point problem
9. Study of levels and levelling staff
10. Fly levelling using Dumpy level & Tilting level
11. Check levelling
12. Study of theodolite
13. LS and CS
14. Measurement of horizontal angles by reiteration and repetition methods using theodolite
15. Measurement of vertical angles using theodolite

SURVEY PRACTICAL - I & SURVEY PRACTICAL – II
LIST OF EQUIPMENTS
(For a batch of 30 students)

S. No.	Description of Equipments	Quantity
1.	Total Station	2 Nos.
2.	Theodolites	Atleast 1 for every 5 students

3.	Dumpy level	Atleast 1 for every 5 students
4.	Plain table	Atleast 1 for every 5 students
5.	Prismatic compass	6 Nos
6.	Pocket stereoscope	1
7.	Ranging rods	
8.	Levelling staff	
9.	Cross staff	1 for a set of 5 students
10.	Chains	
11.	Tapes	
12.	Arrows	

P: 30; TOTAL: 30 PERIODS

19CE41C   **STRENGTH OF MATERIALS**   **L T P C**
                                                         3 1 0 4

COURSE OUTCOMES

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

   CO1: recognize the concept of Energy principles (K3)
   CO2: analyse structures as indeterminate (K3)
   CO3: develop Knowledge on Columns and Cylinders (K3)
   CO4: develop Knowledge on State of stress (K3)
   CO5: develop Knowledge on Unsymmetrical bending, curved beams and Shear centre.
      (K3)

UNIT I   ENERGY PRINCIPLES   12

Strain energy and strain energy density – strain energy in traction, shear in flexure and torsion – castigliano's theorems – principle of virtual work – application of energy theorems for computing deflections in beams and trusses – Maxwell's reciprocal theorems.

UNIT II   INDETERMINATE BEAMS   12

Propped cantilever and fixed beams-fixed end moments and reactions for concentrated load (central, non central), uniformly distributed load, triangular load (maximum at centre and maximum at end) – theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams for continuous beams.

UNIT III   COLUMNS AND CYLINDERS   12

Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns - Eccentrically loaded short columns – middle third rule – core section – columns of unsymmetrical sections – (angle channel sections) – thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells - thick cylinders – compound cylinders.

UNIT IV   STATE OF STRESS IN THREE DIMENSIONS   12

Determination of principal stresses and principal planes – volumetric strain – dilatation and

distortion – theories of failure – principal stress dilatation – principal strain – shear stress – strain energy and distortion energy theories .

UNIT V   ADVANCED TOPICS IN BENDING OF BEAMS   12
Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – curved beams – Winkler Bach formula – stress concentration – Shear flow – Shear centre**.**

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 6th Edition, 2018.
2. Ramamrutham.S, "Strength of Materials", Dhanpat Rai Publishing Company Private Limited, Jan 2008.

REFERENCES
1. Punmia B.C. "Theory of Structures (SMTS)" Vol 1&II, Laxmi Publishing Private Limited, New Delhi, 2004.
2. Rajput R.K. "Strength of Materials", S.Chand& Company Limited, New Delhi, 2006.

19CE42C   APPLIED HYDRAULICS AND HYDRAULIC MACHINES   L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
  CO1:explain concepts of open channel flow, Channel transition and Identify economical Section (K2)
  CO2: compute the flow measurement and specific energy (K2)
  CO3: explain the rapidly varied channel-flow and dam flow profile characteristics (K2)
  CO4: illustrate the performance characteristics of various types of turbines (K2)
  CO5: examine the pumps for various engineering applications based on their performance Curves (K4)

UNIT I   OPEN CHANNEL FLOW   9
Definition and differences between pipe flow and open channel flow - Types of Flow in channels - Properties of open channel - Velocity distribution in open channel –– Determination of roughness coefficients – Manning's and Chezy's formula -Most economical sections – Wide open channel.

UNIT II   UNIFORM FLOW   9
Uniform flow – Flow measurement by notches and weirs – Specific energy– Determination of normal depth and velocity - Critical flow and its computation – Channel Transition -Non-erodible channels.

UNIT III   VARIED FLOW   9
Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Flow through transitions - Hydraulic jump – Types – Energy dissipation – Surges.

UNIT V   TURBINES   9

Impact of jets on plane and curved plates - Classification of Turbines - Reaction turbines-Francis turbine,Radial flow turbines,draft tube and Cavitation- Propeller and Kaplan turbines - Impulse turbines - Perfomance of Turbine - Runway Speed - Similarity laws.

UNIT V   PUMPS   9

Classification of Pumps - Centrifugal pump - Work done - minimum speed to start the pump – NPSH -multistage Pumps – Characteristics curve - reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done - rotary pumps, Gear pump.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Bansal R.K, Fluid mechanics & Hydraulic machines, Laxmi Publishing Private Limited, New Delhi, 2007.
2. Modi, P.N, and Seth S.M. Hydraulic and Fluid Mechanics Standard Book House, 2011.

REFERENCES

1. Jain A.K., "Fluid Mechanics (including Hydraulic Machines", Khanna Publishers, 8th Edition, 1995.
2. Ranga Raju, K.G., "Flow through Open Channels", Tata McGraw-Hill, 1985.
3. Ramamrutham S, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company, 2011
4. VenTe Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
5. Mays L.W., Water Resources Engineering, John Wiley and Sons (WSE), New York, 2005.

19CE43C   WATER SUPPLY TREATMENT AND MANAGEMENT   L T P C
**   3 1 0 4**

COURSE OUTCOMES

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

CO1: examine the various sources of water and their characteristics. (K3)
CO2: classify the different types of conveyance system, pipes and pumping system. (K3)
CO3: design the components of a water treatment plant. (K3)
CO4: explain the various processes of advance water treatment. (K3)
CO5: analyse distribution networks and water supply to buildings. (K3)

UNIT I   PLANNING FOR WATERSUPPLY SYSTEM   12

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   CONVEYANCE SYSTEM   12

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 - Drawings appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

UNIT III   WATER TREATMENT   12
Objectives - Unit operations and processes - Principles, functions design and drawing of flash mixers, flocculators, sedimentation tanks and sand filters – Filter press – Disinfection - Ozonation and UV - Residue Management – TSDF – Co-processing and co-incineration.

UNIT IV   ADVANCED WATER TREATMENT   12
Aerator - Iron and manganese removal- Defluoridation and demineralization - Water softening - Desalination - membrane Systems – Construction, Operation & Maintenance aspects of Water Treatment Plants - Recent advances - Membrane Processes – Arsenic treatment.

UNIT V   WATER DISTRIBUTION AND SUPPLY TO BUILDINGS   12
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.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2014.
2. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Private Limited, New Delhi, 2014.

REFERENCES
1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Syed R.Qasim and Edward M.Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2010.
4. K.N Duggal, "Elements of Water Resource Engineering" New age publishers, New Delhi, 2005.

| 19CE44C | ENGINEERING SURVEY- II | L T P C |
| | | 3 0 0 3 |

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: utilize the concepts of curve for designing (K3)
CO2: utilize the concepts of tacheometric surveying (K3)

CO3: utilize the concepts of control surveying (K3)
CO4: identify probable error and it adjustments in surveying measurements. (K3)
CO5: outline the concepts of celestial bodies and hydrological measurements by using astronomical and hydrographical surveying (K2)

UNIT I   SETTING OUT OF CURVES   9

Curve ranging - Horizontal and vertical curves - Simple curves - Setting with chain and tapes, tangential angles by theodolite, double theodolite - Compound and reverse curves - Transition curves - Functions and requirements - Setting out by offsets and angles - Vertical curves - Sight distances.

UNIT II   TACHEOMETRIC SURVEYING   9

Tachometric systems - Tangential, stadia and subtense methods - Stadia systems - Horizontal and inclined sights - Vertical and normal staffing - Fixed and movable hairs - Stadia constants – Anallatic lens - Subtense bar.

UNIT III   CONTROL SURVEYING   9

Working from whole to part - Horizontal and vertical control methods - Triangulation - Signals - Base line - Instruments and accessories - Satellite station - Reduction to centre – Trilateration - Trigonometric leveling - Single and reciprocal observations – Bench marking.

UNIT IV   SURVEY ADJUSTMENTS   9

Errors - Sources, precautions and corrections - Classification of errors - True and most probable values - Weighted observations - Method of equal shifts - Principle of least squares - Normal equation - Correlates - Level nets - Adjustment of simple triangulation networks.

UNIT V   ASTRONOMICAL AND HYDROGRAPHIC SURVEYING   9

Celestial sphere-Astronomical terms and definitions-Motion of sun and stars-Apparent altitude and corrections–Celestial co-ordinate systems-Nautical almanac-Star constellations -Practical astronomy - Field observations and calculations for azimuth-Hydrographic Surveying-Tides - MSL - Sounding methods - Location of soundings and methods - Three point problem - Strength of fix - Sextants and station pointer .

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Punmia B.C., "Surveying", Vols. II and III, Laxmi Publications, 2005.
2. Kanetkar T.P., "Surveying and Levelling", Vol.II, United Book Corporation, Pune, 2006.

REFERENCES
1. Clark D., "Plane and Geodetic Surveying", Vols. I and II, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2006.
2. James M.Anderson and Edward M.Mikhail, "Introduction to Surveying", McGraw-Hill Book Company, 2012.
3. Bannister A. and Raymond S., "Surveying", ELBS, 6th Edition, 2006.

19CE45C   **SOIL MECHANICS**   **L T P C**
                                                                     3 1 0 4

COURSE OUTCOMES

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

    CO1: classify the soil based on Index and Engineering properties (K2)

    CO2: explain the principle of soil water movement and its effect on stress distribution (K2)

    CO3: explain the stresses in the soil and principle of consolidation (K2)

    CO4: determine the shear strength parameters of soil (K2)

    CO5: analyse the stability of slopes and slope protection measures (K2)

UNIT I   INDEX PROPERTIES AND COMPACTION   12

Nature of Soil - Problems with soil - phase relation -Index properties – clay mineralogy structural arrangement of grains - sieve analysis - sedimentation analysis – Atterberg's limits - Classification for engineering purposes - BIS Classification system - Soil compaction - factors affecting compaction – Field compaction methods.

UNIT II   SOIL WATER, PERMEABILITY AND EFFECTIVE STRESS   12

Soil water – Various forms – Capillary rise – Suction - Effective stress concepts in soil – Total, neutral and effective stress distribution in soil - Permeability – Darcy's Law- Permeability measurement in the laboratory – field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils - Quick sand condition - Seepage –Laplace Equation - Introduction to flow nets –Properties and uses - Application to simple problems.

UNIT III   STRESS DISTRIBUTION, COMPRESSIBILITY AND SETTLEMENT   12

Stress distribution in soil media – Boussinesque formula – Stress due to line load and Circular and rectangular loaded area - Approximate methods - Use of influence charts - Components of settlement - Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory - Laboratory consolidation test –Computation of rate of settlement. – $\sqrt{t}$ and log t methods. e-log p relationship consolidation settlement N-C clays – O.C clays - Problems on final and time rate of consolidation.

UNIT IV   SHEAR STRENGTH   12

Shear strength of cohesive and cohesionless soils - Mohr - Coulomb failure theory - Measurement of shear strength, direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Factors influences shear strength of soil- Liquefaction of sand.

UNIT V   SLOPE STABILITY   12

Slope failure mechanisms - Modes - Infinite slopes - Finite slopes –- Method of slices – Modified Bishop's method - Friction circle method - Stability number – Problems – Slope protection measures.

                                        L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Private Limited, 16th Edition, 2017.
2. Arora, K.R, "Soil Mechanics and Foundation Engineering", Standard Publishers, 7th Edition, 2017 (Reprint).

REFERENCES
1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Limited., New Delhi, 2014.
2. Craig.R.F., "Soil Mechanics", E & FN Spon, London and New York, 2012.
3. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics", New Age International Publication, 3rd Edition, 2016.
4. Palanikumar.M., "Soil Mechanics", Prentice Hall of India, Learning Private Limited Delhi, 2013.

19CE46C   **CONCRETE TECHNOLOGY**   **L T P C**
                                                            3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: explain the suitability of ingredients of concrete and their testing methods. (K2)
   CO2: explain Properties of concrete and testing procedures of concrete in plastic and hardened state. (K2)
   CO3: infer quality control and design concrete mixes by various methods. (K2)
   CO4: summarize durability of concrete and concreting under special circumstances. (K2)
   CO5: outline the properties of special concretes and its applications. (K2)

UNIT I   INGREDIENTS OF CONCRETE   9
Cement –constituents –Hydration-Types of cement-Test on cement as per BIS specifications - Aggregates - Properties and tests as per BIS- Quality of water – Admixtures-Chemical admixture and mineral admixture.

UNIT II   PROPERTIES OF CONCRETE   9
Workability – Segregation – Bleeding – Strength – Stress - Strain characteristics – Modulus of Elasticity – Shrinkage – Creep – Permeability – Destructive tests - Non-Destructive Tests.

UNIT III   CONCRETE MIX DESIGN AND QUALITY CONTROL OF CONCRETE   9
Statistical quality control - Sampling and testing – Acceptance criteria – Factors influencing the design mix – Mix Design by ACI and IS method.

UNIT IV   DURABILITY AND CONCRETE UNDER SPECIAL CIRCUMSTANCES   9
Durability – Chemical attack – Corrosion and its preventive measures - Underground Construction –Under water Construction –Extreme weather concreting.

UNIT V   SPECIAL CONCRETES   9

High Strength concrete – High Performance Concrete – Reactive powder concrete – Light weight concrete - Mass concrete – Self Compacting Concrete – Polymer Concrete - Geopolymer Concrete – Fibre Reinforced Concrete – Ready Mix Concrete – Ferro cement – Shortcrete – Vacuum concrete.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Shetty M.S., "Concrete Technology", S.Chand& Company, New Delhi, 2014.
2. Gambhir M.L., "Concrete Technology", Tata Mc-Graw Hill Company, Noida, 2011.

REFERENCES
1. Orchard D.F., "Concrete Technology", Vol I &II, 1998
2. Neville A.M., "Properties of Concrete", Pearson Education, 2008
3. Santhakumar. A.R, "Concrete Technology", Oxford University Press, 2007.
4. IS10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

19CE47C	ENGINEERING SURVEY PRACTICAL - II	L T P C
		0 0 2 1

COURSE OUTCOMES
Upon Successful completion of this course, the student will able to
    CO1: apply knowledge for setting out of simple and transition curve (K3)
    CO2: apply knowledge to find horizontal angle, vertical angle and distance using theodolite. (K3)
    CO3: describe the features of total station for field measurements.(K2)

LIST OF EXPERIMENTS
1. Theodolite survey traverse
2. Tacheometry
    (i)   Tangential system
    (ii)   Stadia system
    (iii) Subtense system
3. Setting out works
    (i)   Foundation marking
    (ii)   Simple curve by Rankine"s method & Two Theodolite method
    (iii) Transition curve
4. Triangulation – Single plane method – Double plane method
5. Sun / Star observation to determine azimuth
6. Traversing by total station

P: 30; TOTAL: 30 PERIODS

19CE48C	HYDRAULIC ENGINEERING LABORATORY	L T P C
		0 0 2 1

COURSE OUTCOMES
Upon Successful completion of this course, the student will able to

CO1: apply knowledge on flow measurements in pipes and open channels (K3)
CO2: calculate the performance on hydraulic machineries (K3)
CO3: apply knowledge on pipe layouts and design pumps for residential buildings (K3)
CO4: apply the knowledge of selecting pumps in different conditions. (K3)

LIST OF EXPERIMENTS
1. Determination of co-efficient of discharge for orifice
2. Determination of co-efficient of discharge for notches
3. Determination of co-efficient of discharge for venturimeter
4. Determination of co-efficient of discharge for orifice meter
5. Study of impact of jet on flat plate (normal / inclined)
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 pumps (Constant / variable speed)
12. Study on performance characteristics of reciprocating pump.

LIST OF EQUIPMENTS
(For a batch of 30 students)

I. Bernoulli's theorem – Verification Apparatus
II. Flow Measurement open channel flow
    1. Channel with provision for fixing notches (rectangular, triangular & trapezoidal forms)
III. Flow measurement in pipes
    1. Venturimeter, U tube manometer fixtures like Valves, collecting tank
    2. Orifice meter, with all necessary fittings in pipe lines of different diameters
    3. Calibration of flow through orifice tank with Provisions for fixing orifices, collecting tank
    4. Calibration of flow through mouth piece Tank with provisions for fixing mouth pieces Viz external mouth pieces .
IV. Losses in Pipes
    1. Major loss – Friction loss- Pipe lengths (min. 3m) of different diameters with Valves and pressure rapping & collecting tank
    2. Minor Losses   -Pipe line assembly with provisions for having Sudden contractions in diameter, expansions Bends, elbow fitting, etc.
V. Pumps
    1. Centrifugal pump assembly with accessories (single stage)
    2. Centrifugal pump assembly with accessories (multi stage)
    3. Reciprocating pump assembly with accessories
    4. Deep well pump assembly set with accessories

VI. Turbine
  1. Impulse turbine with assembly and fittings
  2. Francis turbine with assembly and fittings
  3. Kaplan turbine with assembly and fittings

P: 30; TOTAL: 30 PERIODS

19CE51C	BASIC STRUCTURAL ANALYSIS	L T P C
		3 1 0 4

COURSE OUTCOMES

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

  CO1: Use the strain energy principles in determinate and indeterminate structures (K2)
  CO2: Construct influence line diagrams for a structure under moving load. (K2)
  CO3: Determine the unknown forces in three hinged two hinged arches. (K2)
  CO4: Determine the unknown forces in continuous beams and rigid frames by slope defection method. (K2)
  CO5: Determine the unknown forces in continuous beams and rigid frames by moment distribution method. (K2)

UNIT I   STRAIN ENERGY METHOD   12

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

UNIT II   INFLUENCE LINE METHOD   12

Influence lines for reactions in statically determinate structures –Influence lines for shear force and bending moment in beam sections - influence lines for member forces in pin jointed plane frames. - Influence line for support reactions, shearing force and bending moments for indeterminate beams - propped cantilevers, fixed beams and continuous beams - Muller Breslau's principle.

UNIT III   ARCHES   12

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

UNIT IV   SLOPE DEFLECTION METHOD   12

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

UNIT V   MOMENT DISTRIBUTION METHOD   12

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

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. R.C.Hibbeler, Structural Analysis in SI units, Pearson India, Ninth Edition, 2017.
2. Bhavikatti,S.S, Structural Analysis, Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi-4, 2014.

REFERENCES
1. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications, 2004.
2. Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publishers,2015.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., 2011.
4. CS Reddy, Basic Structural Analysis, Tata McGraw Hill Publication, 2011.

19CE52C   DESIGN OF REINFORCED CONCRETE ELEMENTS   L T P C
3 1 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Design the reinforced concrete flexural members by working stress method. (K3)
CO2: Design the reinforced concrete beams, slabs by limit state method. (K3)
CO3: Design and identify the behavior of reinforced concrete subjected to bond, anchorage, shear and torsion by limit state method. (K3)
CO4: Design the different types of reinforced concrete columns by limit state method.(K3)
CO5: Design the reinforced concrete footings by limit state method. (K3)

UNIT I   METHODS OF DESIGN OF CONCRETE STRUCTURES   12
Materials for Concrete – Stress-Strain curve for concrete and reinforcing steel – Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods – Design codes and specification – Limit State philosophy as detailed in IS code – Design of flexural members and slabs by working stress method – Properties of un-cracked section.

UNIT II   LIMIT STATE DESIGN OF BEAMS (FLEXURE,SHEAR,TORSION)   12
Design of singly and doubly reinforced rectangular, flanged and continuous beams – Design Requirements for RC members in bond and Anchorage as per current code – Detailing.

UNIT III   LIMIT STATE DESIGN OFSLABS, STAIRCASE   12
Design of one way and two way rectangular slabs subjected to uniformly distributed load for various boundary conditions and corner effects – Design of ordinary and dog legged staircases - Detailing.

UNIT IV   LIMIT STATE DESIGN OF COLUMNS   12

Types of columns – Short and Long column - Braced and Unbraced columns – Design of short column for circular, rectangular, square under axial, uniaxial and biaxial bending – Detailing.

UNIT V   LIMIT STATE DESIGN OF FOOTING   12

Design of wall footing – Design of pad and sloped footing for axially and eccentrically loaded rectangular footing – Design of combined rectangular footing for two columns only – Detailing.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS
1. M.L.Gambhir, "Fundamentals of Reinforced Concrete Design", PHI Learning Publishing Company Pvt. Ltd.,2006.
2. UnnikrishnaPillai.S., DevdasMenon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., NewDelhi
3. Jain, A.K., "Limit State Design of RC Structures", Nemchand Publications,Rourkee
4. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi.

REFERENCES
1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi 2002.
2. Krishna Raju.N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi, 2003.
3. Subramanya.N., "Design of Reinforced Concrete Structures", Oxford Publications, 2011.

19CE53C	WASTE WATER TREATMENT AND MANAGEMENT	L T P C
		3 1 0 4

COURSE OUTCOMES

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

CO1**:** Interpret the composition of sewage, estimate the wastewater generation and design of sewer system (K2)

CO2: Attribute the type of treatment system and to perform basic design of sewage treatment (K2)

CO3: Select the suitable sewage treatment process (K2)

CO4: Perceive the advance sewage treatment technologies (K2)

CO5**:** Describe the concepts of self-purification of streams and sludge disposal methods (K2)

UNIT I   PLANNING AND DESIGN OFSEWERAGESYSTEM   12

Sources, Characteristics of sewage and its composition - population equivalent - Estimating quantity of sewage - Storm runoff estimation - Sewerage - separate, combined and partially seperate system - Hydraulic design of flow in sanitary sewers - sewer materials -Laying and testing - sewer appurtenances – sewage pumping - Discharge standards for Effluents

UNIT II   PRIMARY TREATMENTOFSEWAGE   11

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

UNIT III   SECONDARY TREATMENTOF SEWAGE   12

Objectives – Selection of Treatment Methods – Principles, Functions and design - Activated Sludge Process - Natural systems - Ponds and Lagoons - Trickling filters - Rotating biological contactors - Operation and Maintenance aspects.

UNIT IV   ADVANCED SEWAGETREATMENT   12

Hybrid system - SBR - MBR - MBBR - FBR (Basics)- Anaerobic systems - Anaerobic filters - UASB - Biogas recovery- Reclamation and Reuse of sewage - Constructed Wetland - Nutrient removal systems - DEWATS (Basics).

UNIT V   SEWAGE DISPOSAL ANDSLUDGEMANAGEMENT   13

Dilution – Self purification of surface water bodies - Oxygen sag curve – Streeter Phelps equation - Eutrophication - Land Disposal – Sewage farming – Sewage sickness - Sludge Digestion- characterization - Thickening – Dewatering – Drying - Disposal - Septage Management.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOK

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.

REFERENCES

1. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
2. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, WashingtonD.C.,2010
3. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.

19CE54C FOUNDATION ENGINEERING	L T P C
	3 0 0 3

COURSE OUTCOMES

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

CO1: Plan and execute detailed site investigation program to select type of foundation. (K2)

CO2: Determine bearing capacity of shallow foundation based on the soil conditions. (K2)

CO3: Explain the types of footing and raft based on contact pressure distribution. (K3)

CO4: Interpret the load carrying capacity and settlement of piles and pile group.(K2)

CO5: Illustrate the behavior of soil behind retaining structures. (K2)

UNIT I   SITE INVESTIGATION AND SELECTION OF FOUNDATION   9

Scope and objectives – Methods of exploration-Auguring and boring – Wash boring and rotary drilling– Geophysical methods- Depth of boring – Spacing of bore hole – Sampling – Representative and undisturbed sampling – Sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler – Bore log report – Penetration tests (SPT and SCPT) – Data interpretation (Strength Parameters and Liquefaction potential) – Selection of foundation based on soil condition.

UNIT II   SHALLOW FOUNDATION   9

Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits–Terzaghi's formula and BIS formula–factors affecting bearing capacity – Problems - Bearing Capacity from insitu tests (SPT, SCPT and plate load) – Allowable bearing pressure, Determination of settlement of foundations on granular and clay deposits – Total and differential settlement - Allowable settlements – Codal provision – Methods of minimizing settlement, differential settlement.

UNIT III   FOOTING SANDRAFTS   9

Types of foundation – Contact pressure distribution and settlement below footings and raft - Isolated and combined footings – Types and proportioning - Mat foundation– Types, applications uses and proportioning-principle of floating foundation- Seismic force considerations-Codal provisions.

UNIT IV   PILES   9

Types of piles and their function – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil - Static formula - Dynamic formulae (Engineering news and Hiley's)– Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity – Group capacity by different methods (Feld"s rule, Converse Labarre formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test – Forces on pile caps – Under reamed piles – Capacity under compression and uplift-Codal provisions

UNIT V   RETAINING WALLS   9

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provision.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
2. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi.2014.
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition, 2017.

REFERENCES

1. Das, B.M. "Principles of Foundation Engineering", Thompson Asia Pvt. Ltd., 8th Edition, Singapore, 2013.
2. Joseph E Bowles, "Foundation Analysis and design", McGraw Hill Education, 5th Edition, 28th August 2015.
3. Varghese, P.C., "Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2005.

19CE55C   **HIGHWAY ENGINEERING**   **L T P C**
                                                              3 0 0 3

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to
   CO1: Illustrate the highway planning, engineering surveys for highway alignment. (K2)
   CO2: Design the geometric features of highway elements (K3)
   CO3: Design the flexible and rigid pavements (K3)
   CO4: Identify the desirable properties of highway materials and its standards & various practices adopted for construction. (K2)
   CO5: Evaluate the various defects in pavements and its treatment. (K2)

UNIT I   HIGHWAY PLANNING AND ALIGNMENT   9

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods (Remote Sensing, GIS and GPS techniques) - Classification of highways – Locations and functions – Typical cross sections of Urban and Rural roads

UNIT II   GEOMETRIC DESIGN OF HIGHWAYS   9

Cross sectional elements - 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 [IRC Standards Only].

UNIT III   DESIGN OF FLEXIBLE ANDRIGID PAVEMENT   9

Pavement components and their functions - Design principles of Flexible and Rigid pavement- factors affecting the Design of pavements -Design practice for flexible and rigid Pavements (IRC methods only) – Embankments- Problems in Flexible pavement design.

UNIT IV   HIGHWAY MATERIALS AND CONSTRUCTION PRACTICE   9

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Water Bound macadam Road, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Quality control measures - Highway drainage –– Construction machineries.

UNIT V   HIGHWAY MAINTENANCE   9

Types of Pavement -Types of defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments. -Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks Spalling of Joints and Mud Pumping – and Special Repairs. - Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening - Overlay design by Benkelman Beam Method [Procedure only].

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Veeraragavan. A, Khanna.K and Justo.C.E.G. Highway Engineering, Nem Chand & Bros Publishers,2014
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai,2010
3. Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers, 2017.

REFERENCES

1. Kadiyali. L. R. Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 8thEdition2013
2. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design ofhighways.
3. Sharma.S.K, Principles, Practices and Design of Highway Engineering, S.Chand and CompanyLtd, 2014

19CE56C   PROFESSIONAL ETHICS AND HUMAN VALUES   L T P C
                                                                     3 0 0 3

COURSE OUTCOMES

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

CO1: Recognize the core human values that shape the ethical behavior of an engineer. (K2)
CO2: Expose awareness on professional ethics. (K2)
CO3: Analyze the engineering ethical breach from past study. (K2)
CO4: Distinguish and apply safety, responsibility and rights in workplaces. (K2)
CO5: Discuss about the global issues with regard to ethics. (K2)

UNIT I   HUMAN VALUES   9

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II   ENGINEERING ETHICS   9

Senses of 'Engineering Ethics' - variety of moral issued - 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   9
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Case study: The challenger disaster.

UNIT IV   SAFETY, RESPONSIBILITIES AND RIGHTS   9
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

UNIT V   GLOBAL ISSUES   9
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility

L: 45 TOTAL: 45 PERIODS

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

REFERENCES
1. John R Boatright, "Ethics and the Conduct of Business", 4th Edition, Pearson Education, New Delhi, 2017.
2. Charles D and Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2012.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Fourth Edition, Wadsworth Thompson Learning, United States, 2005.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.

19MC02C	CONSTITUTION OF INDIA	L T P C
		3 0 0 0

COURSE OUTCOMES
Upon completion of this course, the students will be able to
    CO1: describe the salient features of the Indian Constitution. (K2)
    CO2: discuss the structure and functions of parliament. (K2)

CO3: elaborate the structure and functions of state legislature. (K2)
CO4: explain the fundamentals of organization and working of the Judiciary. (K2)
CO5: discuss the foreign policy of India. (K2)

UNIT I INDIAN CONSTITUTION 9

Salient Features – Preamble-Pillars of constitution - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

UNIT II PARLIAMENTARY SYSTEM 9

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III FEDERAL SYSTEM 9

Features of Federal System - Administrative Relationship between Union and States - Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

UNIT IV THE JUDICIARY 9

Organization and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT V INTERNATIONAL POLITICS 9

Foreign Policy of India – VISA Application Process- International Institutions like UNO, WTO, SAARC and Environmentalism.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES
1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, New Delhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.
3. Shukla V N,"Constitution of India", Eastern Book Company Ltd., New Delhi, 2011.

19CE57C   CONCRETE AND HIGHWAY ENGINEERINGLABORATORY   L T P C
0 0 2 1

COURSE OUTCOMES
Upon Successful completion of the course student will able to
CO1   : Determine the physical properties of constituent materials of concrete (K2)
CO2   : Determine the properties of bricks andblocks (K2)

CO3 : Determine the properties of fresh concrete (K2)
CO4 : Determine the properties of hardened concrete (K2)
CO5 : Determine the properties of highwaymaterials (K2)

LIST OFEXPERIMENTS

I. TEST ONCEMENTS
a Determination of Consistency ofcement
b Determination of Initial & Final Setting time of cement
c Determination of Soundness ofcement
d Determination of Compressive strength ofcement

II. TESTS ON BRICKS AND BLOCKS
a Test for compressive strength of bricks and blocks
b Test for water absorption of bricks andblocks

III. TESTS ON FRESH CONCRETE
a Determination of workability of concrete by slump test and casting ofspecimens

b Determination of flow percent of concrete by Flow tabletest
c Determination of workability of concrete by compaction factor test and casting of specimens
d Determination of consistency of concrete by Vee beetest.

IV. TESTS ON HARDENEDCONCRETE
a Determination of Compressive strength of concrete Cube
b Determination of Splitting tensile strength ofcylinder
c Determination of Modulus of Rupture of concretebeam
d Determination of Modulus Of Elasticity of concretespecimen

V. TESTS ONBITUMEN
a Determination of Penetration value of bitumen
b Determination of Softening Point of bitumen
c Determination of Ductility value ofbitumen
d Determination of Viscosity ofbitumen
e Determination of Elastic Recovery ofbitumen

VI. TESTS ONAGGREGATES
a Determination of Particle size distribution and fineness modulus of Coarse Aggregate
b Determination of Water Absorption & Specific gravity of CoarseAggregate
c Determination of Impact Value of coarseAggregate
d Determination of Crushing value of CoarseAggregate
e Determination of Particle size Distribution of fineAggregate

VII. TESTS ON BITUMINOUSMIXES
a Determination of Binder Content value of bituminousmix

b Determination of Marshall Stability and Flow values of bituminous mix

c Determination of California Bearing Ratio value of subgradesoil.

P: 30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No	DESCRIPTION OF EQUIPMENTS	QUANTITY
1.	Concrete cube moulds	6
2.	Concrete cylinder moulds	3
3.	Concrete Prism moulds	3
4.	Sieves	1 set
5.	Concrete Mixer	1
6.	Slump cone	3
7.	Flow table	1
8.	Vibrator	1
9.	Trovels and planers	2 set
10.	Vee Bee Consistometer	1
11.	Aggregate impact testing machine	1
12.	Blains Apparatus	1
13.	Compression Testing Machine 200T capacity	1
14.	Flexure Testing Machine	1
15.	Compressometer	1
16.	Le Chatelier's apparatus	2
17.	Vicat's apparatus	2
18.	Mortar Cube moulds	10

19CE58C	**SOILMECHANICSLABORATORY**	**L T P C**
		0 0 2 1

COURSE OUTCOMES

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

CO1: Determine the index properties of soil. (K3)

CO2: Determine the engineering properties of soil. (K3)

LIST OF EXPERIMENTS

1. Grain size distribution - Sieveanalysis.
2. Grain size distribution - Hydrometeranalysis.
3. Specific gravity of soilgrains.
4. Relative density ofsoil.
5. Atterberg limitstest.
6. Determination of moisture - Density relationship using standard Proctortest.
7. Field density test (Core cutter and sand replacementmethods).
8. Permeability determination (constant head and falling headmethods).
9. Direct shear test in cohesionlesssoil.
10. Unconfined compression test in cohesivesoil.
11. Laboratory Vane Shear Test in cohesivesoil.
12. Triaxial compression test (Demonstrationonly).
13. One dimensional consolidation test (Demonstrationonly).

P: 30; TOTAL 30 PERIODS

LIST OF EQUIPMENTS
(For a batch of 30 students)

Sl. No.	DESCRIPTION OF EQUIPMENTS	QUANTITY
1.	Sieves	2 sets
2.	Hydrometer	2 sets
3.	Liquid and plastic limit apparatus	2 sets
4.	Shrinkage limit apparatus	3 sets
5.	Proctor compaction apparatus	1 set
6.	Relative Density apparatus	1
7.	Thermometer	2
8.	Direct shear apparatus	1
9.	Unconfined Compression Testing apparatus	1
10.	Field density measuring devices	2
11.	Triaxial shear apparatus	1
12.	Three gang consolidation test device	1
13.	Vane Shear Apparatus	1

19CE61C **ESTIMATION AND COSTING** **L T P C**
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Describe the basic concept of quantity estimation for engineering and Irrigation structures (K2)

CO2: Determine the quantities for various structures (K2)

CO3: Conduct the rate analysis for different building works and roads. (K2)

CO4: Write the report on estimation of residential building, culverts and roads. (K2)

CO5: Illustrate various types of valuation and its methods involved in land and buildings. (K2)

UNITI QUANTITY ESTIMATION OF BUILDINGS 9

Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates –Detailed estimate– Estimation of quantities for framed and load bearing structures.

UNITII QUANTITY ESTIMATION OFOTHER STRUCTURES 9

Estimating of septic tank, soak pit –– Open well – Estimate of bituminous and cement concrete roads – embankments - Estimate of retaining walls – culverts – arches - Estimating of irrigation works – aqueduct, fall.

UNITIII RATE ANALYSISANDCOSTING 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 and Roads– Cost Estimates.

UNITIV SPECIFICATIONS, REPORTSAND TENDERS 9

Specifications – Detailed and general specifications –Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads – Tender notices – types – tender procedures.

UNITV INTRODUCTION TOVALUATION 9

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

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS

1. B.NDutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2010.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', University Press,2006
3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House,1998

REFERENCES

1. Hand Book of Consolidated Data – 8/2000, Vol.1,TNPWD
2. Tamil Nadu Transparencies in Tenders Act,1998
3. Arbitration and Conciliation Act, 199676
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April1996
5. Standard Data Book for Analysis and Rates, IRC, New Delhi,20

19CE62C   **CONSTRUCTION ENGINEERING AND MANAGEMENT**   **L T P C**
                                                                3 0 0 3

COURSE OUTCOMES

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

    CO1: Outline the features of construction industry (K2)

    CO2: Develop a network plan for construction project (K3)

    CO3: Develop a schedule and manage the resources for construction project (K3)

    CO4: Prepare the contract documents based on IBRD/MORTH standards (K2)

    CO5: Manage cost, finance, quality and safety in construction project (K2)

UNIT I   **INTRODUCTION TO CONSTRUCTION INDUSTRY**   **9**

Introduction- Construction Industry - Project Participants - Characteristics of projects-Project life cycle - Construction Organization - Work Breakdown Structure.

UNIT II   **PROJECT PLANNING MANAGEMENT**   **9**

Estimating project time and cost planning - Developing a network plan - Bar chart - Activity on Arrow (AOA) - Activity on Node (AON) - Precedence network- Introduction to application software.

UNIT III   **SCHEDULING AND RESOURCE MANAGEMENT**   **9**

Scheduling - Network analysis- Start and finish time – Floats - Critical path Project Update - Project Controls - Schedule Compression- Cost-Time Trade Off (Network Crashing) - Resource Management - Resource Scheduling - Construction Procurement - Inventory control – Equipment management - Material management.

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   **COST CONTROL MANAGEMENT**   **9**

Cost Management – Introduction to financial management - Quality management - safety - Site Management & Administration.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Verma L.C., Standardisation - A New Discipline Peurifoy R.L.,& Ledbetter W.B., Construction Planning Equipment & Methods.
2. K.K.Chitkara, "Construction Project Management", Tata McGraw-Hill Education,2009

REFERENCES

1. Vazirani V.N. &Chandola S.P., "Heavy Construction", KhannaPublications.
2. Jha J. & Sinha S.K., "Construction & Foundation Engineering", KhannaPublications.

19CE63C   SOLID WASTE MANAGEMENT, AIR AND NOISE   L T P C
POLLUTION CONTROL   4 0 0 4

COURSE OUTCOMES

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

   CO1: Identify the sources of municipal solid wastes and methods to reduce solid wastes. (K2)

   CO2: Conceptualize the collection and transfer methods of solid waste from source (K2)

   CO3: Handle and disposal of municipal solid waste.(K2)

   CO4: Identify the sources of air pollution, their impacts and air quality management (K2)

   CO5: Select the appropriate control method for particulate and gaseous pollutants.(K2)

UNITI   SOURCES, CHARACTERISTICS, ON-SITE STORAGE AND PROCESSING   11

Sources and types of municipal solid wastes - waste generation rates - factors affecting generation - composition - methods of sampling and characterization - Onsite storage methods - Handling and segregation at source - source reduction of waste and 3R Concept.

UNITII   COLLECTION, TRANSFER AND PROCESSING OF SOLID WASTE   13

Methods of collection – Collection vehicles – Manpower – Collection routes and their optimization - Analysis of collection systems - Transfer stations - operation & maintenance - Objectives of waste processing – Physical Processing techniques and Equipment - Thermal processing options - Resource recovery from solid waste

UNITIII   DISPOSAL OF MUNICIPAL SOLID WASTE   9

Land disposal of solid waste - Sanitary landfills - site selection, design and operation of sanitary landfills– Landfill liners - Leachate management and treatment.

UNITIV   SOURCES, IMPACTS OF AIR POLLUTION AND AIRQUALITY
MODELING   14

Structure and composition of Atmosphere – Definition and scope of Air Pollution - Sources and classification of air pollutants - effects on human health, vegetation, animals - Effects of meteorology on Air Pollution - Atmospheric stability, Inversion, Wind -profiles and stack plume patterns - Ambient air and stack sampling - Mechanism of dispersion of air pollutants - Dispersion models - Ambient Air Quality and Emission standards -Sources, types and control of indoor air pollutants.

UNITV   CONTROL OF PARTICULATE AND GASEOUS POLLUTANTS   13

Gas Particle Interaction - Factors affecting Selection of Control Equipment – Particulates - Working principle, Performance evaluation of Gravity Separators, Centrifugal separators, Particulate Scrubbers, Electrostatic Precipitators - Gaseous pollutants - Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio

scrubbers, Bio filters. - Noise Pollution - Sources and Effects– Measurement – Standards – Control and Preventive measures.

L: 60; TOTAL: 60 PERIODS

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, 1stEdition, 2015
2. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018.

REFERENCES

1. William A. Worrell, P. AarneVesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rdEdition, Cengage Learning,2017.
2. David H.F. Liu, Bela G. Liptak , "Air Pollution" , Lweis Publishers,2000
3. MN RAO and HVN RAO air pollution, Tata Mc-Graw Hill publishing company limited2007.
4. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.

| 19CE64C | DESIGN OFSTEELSTRUCTURES | L T P C |
| | | 3 0 0 3 |

COURSE OUTCOMES

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

CO1: Design of simple and eccentric connections. (K3)
CO2: Design tension members by appropriate identification of structural steel. (K3)
CO3: Design compression members by appropriate identification of structural steel. (K3)
CO4: Design the members subjected to bending and Lateral torsional buckling. (K3)
CO5: Design the components of Industrial roofing. (K3)

UNITI INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS 9

Properties of steel – Structural steel sections –Section classifications - Limit State Design Concepts– Loads on Structures – Design of bolted, welded connections – Eccentric connections –Types of failure – Efficiency of connections – prying action – HSFG bolts

UNITII TENSION MEMBERS 9

Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

UNITIII COMPRESSION MEMBERS 9

Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base

UNITIV   BEAMS   9

Types of simple beam connections –Plastic analysis of beams - Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Web splices

UNITV   ROOF TRUSSES ANDINDUSTRIAL STRUCTURES   9

Roof trusses – Roof and side coverings – Design loads – design of purlin and elements of truss for simple trusses– end bearing – Design of gantry girder and gantry columns – Introduction to Pre- engineered building.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi,2016
2. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010.
3. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.

REFERENCES
1. "Teaching Resources for Structural Steel Design – Vol. I & II", INSDAG,Kolkatta.
2. Ramachandra.S and VirendraGehlot, "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi,2007
3. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Private Limited,2013

19CE65C	STRUCTURAL DESIGN AND DRAWING	L T P C
		0 0 4 2

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

CO1: Design various elements of Retaining wall / Water tanks / Truss / Framed Structures. (K3)

CO2: Sketch the structural drawings of a various elements of Retaining wall / Water tanks /Truss / Framed Structures using AutoCAD. (K3)

CO3: Analyze truss/framed structures using STAAD Pro software (K3)

LIST OF EXPERIMENTS
1. Analysis and design of multi storied framed structure using analyzing software.
2. Analysis and design of a steel truss system using analyzing software.
3. Design and detailing of Reinforced Cement Concrete cantilever and counter fort type retaining walls with reinforcement details.
4. Design of solid slab and Reinforced Cement Concrete Tee beam bridges for Indian Road Congress loading and reinforcement details.
5. Design and detailing of overhead water tank, circular and rectangular watertanks.

P: 60; TOTAL: 60 PERIODS

LIST OF EQUIPMENTS

1. Desktop Systems -30

2. Drafting Software -1

3. Analyzing and design software -1

19CE66C	ENVIRONMENTALENGINEERINGLABORATORY	L T P C
		0 0 2 1

COURSE OUTCOMES

Upon Successful completion of this course, the students will able to

CO1: Determine the quality parameters of water (K2)
CO2: Determine the quality parameters of wastewater (K2)

LIST OF EXPERIMENTS

1. Sampling, Preservation methods and Characterization of water and wastewater (Demonstration only)
2. Determination of pH and Electrical Conductivity
3. Determination of Turbidity and Hardness
4. Determination of Iron & Fluoride in water
5. Determination of Residual Chlorine
6. Determination of Chloride
7. Determination of Sulphate
8. Determination of Optimum Coagulant Dosage by jar test apparatus
   i) Alum dozing   ii) Lime dozing
9. Determination of available Chlorine in Bleaching powder
10. Determination of Dissolved Oxygen
11. Determination of Solids
12. Estimation of C.O.D.
13. Estimation of B.O.D.
14. Determination of Ammonia Nitrogen
15. Introduction to Bacteriological Analysis (Demonstration only)

LIST OF EQUIPMENTS (For a batch of 30 students)

Sl. No.	Description of Equipments	Quantity
1.	pH meter	1 No.
2.	Turbidity meter	1 No.
3.	Conductivity meter	1 No.

4.	Refrigerator	1 No.
5.	BOD incubator	1 No.
6.	Muffle furnace	1 No.
7.	Hot air oven	1 No.
8.	Desicator	1 No.
9.	Jar test apparatus	1 No.
10.	Water bath	1 No.
11.	Furniture	1 lot
12.	Glass wares / Crucibles	1 lot
13.	COD apparatus	2 Nos.
14.	Kjeldane apparatus	1 No.
15.	Calorimeter	1 No.
16.	Chlorine comparator	1 No.
17.	Beaker	30 Nos.
18.	Magnetic stirrer with hot plates	1 No.
19.	Standard Flask	30 Nos.
20.	Burette with stand	15 Nos.
21.	Pipette	15 Nos.
22.	Crucible	15 Nos.
23.	Filtration assembly	1 No.
24.	Chemicals	1 No.
25.	Chemical balance	1 No.

P: 30; TOTAL: 30 PERIODS

19CE71C	PROJECT MANAGEMENT AND FINANCE	L T P C
	(Common to all Programmes)	3 0 0 0

COURSE OUTCOMES

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

CO1: Explain the concept of operational and project management. (K2)

CO2: Define the scope of a project and develop the project plan. (K2)

CO3: Evaluate the technical, business and social environment related to the project. (K3)

CO4: Formulate and manage project team successfully. (K5)

CO5: Monitor and control projects using tools and techniques. (K3)

UNIT I   BASIC CONCEPT   9

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

UNITII   THE VERTICALSTRUCTURE PLANE   9

Project identification, formulation and preparation. Market and demand estimation - Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost - Financial projections.

UNIT III   PROCESS OF PROJECT APPRAISAL   9

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects. Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost-benefits - treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

UNIT IV   PROJECT TEAM FORMULATION AND MAXIMIZING PARTICIPATION   9

Project Team frame works - Project Team cultures - Barriers and challenges - Selecting Team Members- Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

UNIT V   IMPLEMENTATION, MONITORING AND CONTROL OF PROJECTS   9

Project scheduling, network techniques for resource, cost budgeting and scheduling - project management teams and coordination - Monitoring and post implementation, evaluation of the project - ERP - Project financing.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
  1. Gobalakrishnan P and Ramamoorthy VE "Textbook of Project Management", Macmillan Publications, 2014.
  2. Maylor "Project Management", 3rdEdition, Pearson, 2010.

REFERENCES
  1. Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.
  2. Gray and Larson, "Project Management: The Managerial Process", 3rd Edition, TMH, 2010.
  3. Choudhury S, "Project Management", Tata Mc-Graw Hill Publishing Co.1st Edition, 2007.

19CE72C   **PROJECT WORK – I**   **L T P C**
                                                                        0 0 6 3

COURSE OUTCOMES

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

   CO1: identify an innovate or creative idea / concept / solution to a problem (K3)

   CO2: perform the detailed literature survey related to concept / idea (K2)

   CO3: implement basic prototype to demonstrate the concept (K4)

1. The Project is a theoretical study/analysis / prototype design / modeling and simulation or a combination of these.

2. Should be done as group (preferably four students) project.

3. The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.

4. A project report is required to be submitted in the standard prescribed format.

P: 45; TOTAL: 45 PERIODS

19CE73C	COMPREHENSION	L T P C
		0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: recollect the technical knowledge acquired during the course of study. (K2)
CO2: demonstrate the comprehensive knowledge in technical interviews.(K4)

ASSESSMENT PROCEDURE

1. Review of civil engineering course of earlier semesters will be done by conducting objective type tests.
2. Periodically competitive exam level objective type tests will be conducted and evaluated.
3. Comprehensive viva will be conducted at the end of the semester for the revised courses.

P: 60; TOTAL: 60 PERIODS

19CE81C	PROJECTWORK - II	L T P C
		0 0 12 6

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: design and develop the working model (K3)
CO2: work independently to complete the project along with team members (K2)
CO3: demonstrate the results and documents the report (K4)

Project work shall be based on any of the following:

1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
2. Experimental / Theoretical verification of principles used in the concept.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

4. Research findings, Recommendations and future scope.

P: 180; TOTAL:180 PERIODS

19CE82C	**INTERNSHIP / IN-PLANT TRAINING**	**L T P C**
		0 0 4 2

COURSE OUTCOMES

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

    CO1: acquire the knowledge of different industrial / organizational activities (K2)

    CO2: document the work and communicate effectively through technical presentation (K2)

1. Student shall undergo internship/in-plant training after getting prior permission from the department
2. A report should be submitted after the successful completion of internship / in-plant training.

P: 60; TOTAL: 60 PERIODS

B.E. CIVIL ENGINEERING
PROGRAMME ELECTIVE COURSES

19CE01E **ADVANCEDSTRUCTURALANALYSIS** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method. (K3)

CO2: Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames. (K3)

CO3: Make use of the fundamental theory of FEA method. (K2)

CO4: Analyse the structure using plastic mechanism. (K3)

CO5: Analyse the suspension bridges with stiffening girders.(K3)

UNIT I **FLEXIBLITY METHOD** **9**

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

UNIT II **STIFFNESS METHOD** **9**

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

UNIT III **FINITE ELEMENT METHOD** **9**

Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element– Triangular elements - Plane stress and plane strain.

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 **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.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. R.C.Hibbeler, Structural Analysis in SI units, Pearson India, Ninth Edition, 2017.
2. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2014.

REFERENCES

1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, 2nd Edition, Delhi,2004
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications, 2004.
3. Vazrani.V.N and Ratwani,M.M, Analysis of Structures, Vol-II, Khanna Publishers, 2015.

19CE02E	BRIDGE STRUCTURES	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Examine the type of bridge and its basic requirements for particular location (K3)
CO2: Design the simple kind of bridge structures (K3)
CO3: Design the T- beam concrete bridge structures (K3)
CO4: Design the Steel and Steel Concrete Composite Bridge sections (K3)
CO5: Design the Supporting Structures for Bridges (K3)

UNIT I   INTRODUCTION   9

Investigations and planning, choice of type, linear water way, economic span length, IRC specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT II   SIMPLE BRIDGE STRUCTURES   9

Load Calculation and dispersion -Design of Slab Bridges – Box Culvert- Pipe Culvert.

UNIT III   T- BEAM CONCRETE BRIDGES   9

Pigaud‟s theory, courbon‟s theory- T-Beam Bridges - Prestressed Concrete Bridges.

UNIT IV   STEEL AND STEEL CONCRETE COMPOSITE BRIDGES   9

Design of Truss Bridges - Plate Girder Bridges – Steel Concrete Composite Bridges.

UNIT V   SUPPORTING STRUCTURES   9

Abutments – Piers – Importance of Soil-Structure Interaction – Types of Foundations – Bearings and expansion Joints.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi, 2018.
2. Rajagopalan,N "Bridge Superstructure", Alpha Science International, 2006

REFERENCES

1. Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990.
2. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi, 2017
3. Jagadeesh. T.R. and Jayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2013

19CE03E	STORAGE STRUCTURES	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Design steel water storage structures. (K3)
CO2: Design concrete water storage structures. (K3)

CO3: Design steel industrial storage structures. (K3)
CO4: Design concrete industrial storage structures. (K3)
CO5: Design prestressed concrete water storage structures. (K3)

UNIT I   STEEL WATER TANKS   12

Design of rectangular riveted steel water tank structures – Design of pressed steel water tank structures - Design of hemispherical bottom water tank structures – Design of oil storage structures.

UNIT II   CONCRETE WATER TANKS   12

Design of Circular tanks – Design of Intz tank – Design of rectangular tanks.

UNIT III   STEEL BINS   7

Design of square bunker – Jansen‟s and Airy‟s theories – IS Codal provisions –Design of cylindrical silo.

UNIT IV   CONCRETE BINS   7

Design of square bunker– Design of cylindrical silo..

UNIT V   PRESTRESSED CONCRETE WATER TANKS   7

Principles of circular prestressing – Design of prestressed concrete circular water tanks.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Rajagopalan K., "Storage Structures", Tata McGraw-Hill, New Delhi, 1998.
2. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributors, New Delhi, 2010.
3. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, sixth edition, 2018.

REFERENCES
1. Ramaswamy G.S., "Modern prestressed concrete design", Arnold Heinimen, New Delhi, 1998.
2. Lin T.Y. "Design of prestressed concrete structures, Asia Publishing House", Bombay 2010.
3. David A.Sheppard, William R. and Philips, "Plant Cast precast and prestressed concrete – A design guide", McGraw Hill, New Delhi 1992.

19CE04E	THEORY OF PLATES AND SHELLS	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
    CO1: Understand the Principles of elasticity (K2)
    CO2: Familiarize with the behaviour and analysis of Thin plates (K2)
    CO3: Analyze the behaviour of rectangular plates and circular plates (K3)

CO4: Understand the fundamentals of shells and its classification (K2)
CO5: Analyze the structural behavior of shells. (K3)

UNIT I INTRODUCTION TO THEORY OF ELASTICITY 9

Analysis of Stress: Definition and notation of stress, Equations of equilibrium in differential form, Stress components on an arbitrary plane, Principal stresses, Planes of maximum shear, Stress transformation, Plane state of stress, Mohr's diagram for 3dimensional state of stress. Analysis of Strain: Displacement field, Strains in term of displacement field. Plane state of strain, Compatibility equations.

UNIT II THIN PLATE THEORY 9

Assumptions – Bending of long rectangular plates to a cylindrical surface – Differential equation – Plates with simply supported edges – Plates with built-in edges – Pure bending of plates – Slope and curvature of slightly bent plates – Relation between bending moment and curvature.

UNIT III CLASSICAL APPROACH AND METHODS 9

Small deflections of laterally loaded plates – Differential equation of the deflection surface – Simply supported rectangular plates using different boundary conditions – Navier"s solution for simply supported rectangular plates under a load uniformly distributed over the area of a rectangle - Levy"s method – Advantages over Navier"s solution – Symmetrical bending of laterally loaded circular plates – Differential equation – Uniformly loaded circular plates.

UNIT IV THIN SHELLS 9

Classification of shell surfaces – Surfaces of revolution - Δ-forms of surfaces – Folded plates – Characteristics of shell surfaces – Surfaces and its related aspects – Curvatures of a surface – Curves and related aspects

UNIT V STRUCTURAL BEHAVIOUR OF SHELLS 9

Structural behaviour and various relations – Equilibrium equations – Stress-strain relationships –Equilibrium equations for thin shell elements in membrane state – Curvilinear coordinate system –Shells of revolution – Strain-displacement relations for cylindrical shells.Design of shells based on beam theory - Design aspects of paraboloid, hyperboloid shells.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. S.Timoshenko and J.N. Goodier "Theory of Elasticity Stephen Timoshenko, McGraw Hill Book Company,New York, 2017. Third Edition
2. J.N. Reddy, "Theory and Analysis of Elastic Plates and Shells", Second Edition ,CRC Press, Taylor and Francis Group, Boca Raton ,London , New York ,2016.
3. Prof. K. Bhaskar and Prof. T.K. Varadan (Retd.) Plates: Theories and Applications: Print ISBN:9781118893876 |Online ISBN:9781118894705,Copyright © 2014 John Wiley & Sons, Ltd.
4. Binoy. K. Chatterji, Theory and Design of Concrete Shells , Publisher : Spon Press; Revised edition (1 November 1988)

REFERENCE
1. Rudolph Szilard, "Theories and Applications of Plate Analysis", Wiley India Pvt. Ltd.
2. Bairagi, K .A Text Book of Plate Analysis –, Khanna Publisher, New Delhi.
3. Thin Shell Structures by Bandopadhyay J.N. New Age International Publishers, New Delhi, 2007

19CE05E	TALL BUILDINGS	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Describe the various loads acting on a tall building. (K2)
   CO2: Describe the forces and frames of tall building. (K2)
   CO3: Outline the common high rise structures. (K2)
   CO4: Analyse a tall structure. (K3)
   CO5: Explain the techniques used in high-rise buildings. (K2)

UNIT I   INTRODUCTION   AND LOADING   9
The Tall Building in the Urban Context - The tall building and its support structure - development of high rise building structures - General Planning Considerations. Dead Loads - Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading – Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

UNIT II   THE VERTICAL STRUCTURE PLANE   10
Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement - Behaviour of Shear Walls under Lateral Loading. The Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing-Composite Floor Systems the High – Rise Building as related to assemblage Kits Skeleton Frame Systems - Load Bearing Wall Panel Systems - Panel – Frame Systems - Multistory Box Systems.

UNIT III   BEHAVIOUR OF HIGH RISE STRUCTURES   10
The Bearing Wall Structure- The Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - Dynamic Response.

UNIT IV   ANALYSIS AND DESIGN   9
Approximate Analysis of Bearing Wall Buildings The Cross Wall Structure - The Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings - Shear Wall Structure - Composite Structure - The Hollow Tube Structure.

UNIT V   OTHER HIGH-RISE BUILDING STRUCTURE   7
Deep - Beam Systems – High rise suspension systems - Pneumatic High rise buildings - Space Frame Applied to High rise Buildings - Capsule Architecture.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Bryan Stafford Smith and Alex Coull, Tall Building Structures, Analysis and Design, John Wiley and Sons, Inc., 2011.
2. Taranath B.S, Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, McGraw Hill, 2011.

REFERENCES
1. Coull, A. and Smith, Stafford, B, "Tall Buildings ", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers", John Wiley, 1994.
3. Wolfgang Schueller, High-rise building structures, Publisher: Wiley (January 1, 1977).

19CE06E   **PREFABRICATED STRUCTURES**   **L T P C**
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Outline the basic concepts in Prefabrication. (K2)
   CO2: Infer the different prefabricated components in Structures. (K2)
   CO3: Explain the design the principles of Prefabricated Components. (K2)
   CO4: Design the joints in prefabricated components. (K3)
   CO5: Examine the loading conditions on components. (K2)

UNIT I   INTRODUCTION   9
Need for prefabrication – Principles – Materials – Modular coordination – Standarization – Systems – Production – Transportation – Erection.

UNIT II   PREFABRICATED COMPONENTS   9
Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs– Wall panels – Columns – Shear walls.

UNIT III   DESIGN PRINCIPLES   9
Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

UNIT IV   JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS   9
Types of Joints– Jointing materials – Dimensions and detailing – Design of expansion joints – Types of structural connections – Beam to Beam, Column to Column, Column to Foundation, Connection between wall panels, and Connection between floor panels.

UNIT V   DESIGN FOR ABNORMAL LOADS   9

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994.

REFERENCES
1. Koncz T., "Manual of precast concrete construction, Vols. I, II and III", Bauverlag, GMBH, 1971.
2. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.

19CE07E   **COMPUTER AIDED DESIGN OF STRUCTURES**   **L T P C**
                                                                                                    3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
  CO1**:** Formulate algorithm for solving equations by matrix method and construct algorithm for Computer aided design of truss problems. (K3)
  CO2: Construct algorithm for computer aided design of reinforced concrete members. (K3)
  CO3: Construct algorithm for computer aided design of steel members. (K3)
  CO4: Construct algorithm for analysis of prestressed concrete members. (K3)
  CO5: Acquire the knowledge in Artificial Intelligence and Knowledge based expert systems (K3)

UNIT I   STRUCTURAL ANALYSIS   9
Banded and semi-banded matrices - element stiffness matrix – structure stiffness matrix – algorithm for solving trusses by matrix stiffness method – simple applications.

UNIT II   REINFORCED CONCRETE STRUCTURES   9
Stress-strain relationship in concrete and steel – algorithm for bending moment coefficients in slab – algorithm for developing design tables for beams – rectangular and flanged sections – simple applications.

UNIT III   STEEL STRUCTURES   9
Algorithm for finding load carrying capacity of steel columns – algorithm for moment carrying capacity of steel beams – simple applications.

UNIT IV   PRESTRESSED CONCRETE STRUCTURES   9
Algorithm for analysis of prestressed rectangular and I sections in flexure – algorithm for finding losses in prestress – simple applications.

UNIT V   EXPERT SYSTEMS   9

Introduction to artificial intelligence - Knowledge based expert systems – Rules and decision tables - Inference mechanisms - simple applications.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Limited, New Delhi, 2014.
2. Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 2003

REFERENCES
1. Harrison H.B., "Structural Analysis and Design, Part I and II" Pergamon Press, Oxford, 1990.
2. Rao S.S., "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi, 1977.
3. Richard Forsyth (Ed), "Expert System Principles and Case Studies", Chapman and Hall, London, 1989.

19CE08E   **INDUSTRIAL STRUCTURES**   **L T P C**
                                                                           3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Construct the planning aspects of the Industrial Buildings. (K2)
   CO2: Select functional Requirement of the Industrial Buildings. (K2)
   CO3: Analyze and Design Steel Structures for Industries. (K2)
   CO4: Analyze & Design Concrete Structures for Industries. (K2)
   CO5: Explain the concept of Prefabrications and pre stressingin Industries. (K3)

UNIT I   PLANNING   9
Classification of Industries and Industrial structures – General requirements for industrieslike cement, chemical and steel plants – Planning and layout of buildings and components.

UNIT II   FUNCTIONAL REQUIREMENTS   9
Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act.

UNIT III   DESIGN OF STEEL STRUCTURES   9
Industrial roofs – Crane girders – Mill buildings – Design of Bunkers and Silos–Chimney Cooling Towers (Principles)

UNIT IV   DESIGN OF R.C. STRUCTURES   9
Corbels, Brackets and Nibs - Silos and bunkers – Chimneys – Principles of folded plates and shell roofs

UNIT V   PREFABRICATION   9

Principles of prefabrication – Prestressed precast roof trusses- construction of roof and floor slabs - Wall panels –storage /transportation /handling in yard /site and erection – Joints in precast structures.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Dayaratnam, P., "Design of Steel Structures", 2nd Edition, S.Chand &Company, 2003.
2. Ramachandra, S. and Virendra Gehlot, "Design of Steel Structures – Vol. I & II", 2008. Standard Publication, New Delhi, 2007.
3. Ramamurtham.S "Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company 2007.
4. Varghese P.C "Advanced reinforced Concrete Design", PHI, Eastern Economy, 2nd Edition, 2005.

REFERENCES

1. BhavikattiS.S, "Design of steel structures", J.K .International Publishing House Pvt Ltd, 2009.
2. Subramanian, N., Design of Steel Structures, Oxford University Press, 2008
3. Henn W. Buildings for Industry, Vol.I and II, London Hill Books, 1995.
4. Handbook on Functional Requirements of Industrial buildings, SP32 – 1986, Bureau of Indian Standards, New Delhi 1990.
5. Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Structural Engineering Research Centre, Madras, 1982.
6. Clarence W Dunham , Planning industrial structures, McGraw-Hill Book Co; 1st edition (January 1, 1948)
7. National Building codes

19CE09E   **SMART MATERIALS AND SMART STRUCTURES**   **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Develop knowledge on smart materials and its response on instrumented structures. (K2)

CO2: Explain the concepts of measurement using smart materials (K2)

CO3: Understand the sensing technology in smart structures. (K2)

CO4: Infer the actuator techniques and materials for structural assessment. (K2)

CO5: Apply the data acquisition and data processing techniques for a sensor (K3)

UNIT I   INTRODUCTION   9

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

UNIT II   MEASURING TECHNIQUES   9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance –

Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT III   SENSORS   9
Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVDT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV   ACTUATORS   9
Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials

UNIT V   APPLICATIONS IN CIVIL ENGINEERING   9
Signal Processing and Control for Smart Structures – Sensors for Civil Engineering Structures – Damage detection using sensors – Smart Buildings – Smart Building components such as smart windows.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Brain Culshaw, "Smart Structure and Materials" Artech House Borton, London 1996.
2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, 1st January 1981.

REFERENCES
1. L. S. Srinath, "Experimental Stress Analysis", Tata McGraw-Hill, 1998.
2. J. W. Dally & W. F. Riley, "Experimental Stress Analysis", Tata McGraw-Hill, 1998.

19CE10E	REPAIR AND REHABILITATION OF STRUCTURES	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Understand importance of maintenance and repair strategies (K2)
   CO2: Asses the strength and durability properties of concrete structures (K2)
   CO3: Summarize the special type of concretes (K2)
   CO4: Understand the techniques for repair and protection methods. (K2)
   CO5: Outline the Repair, rehabilitation and retrofitting of structures (K2)

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 damaged structure, causes of deterioration.

UNIT II   STRENGTH AND DURABILITY OF CONCRETE   9
Quality assurance for concrete–Strength, Durability- Cracks, different types, causes–

Effects due to climate, temperature, Sustained elevated temperature, Corrosion.

UNIT III   SPECIAL CONCRETES   9

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, 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, Load Test for Stability-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, earthquake–Structural Health Monitoring- demolition techniques-Engineered demolition methods- Case studies.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Vidivelli.Bl, Rehabilitation of Concrete Structures, Standard Publishes Distribution, 1st Edition, 2009.
2. Dodge Woodson.R, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth- Heinemann, Elsevier, New Delhi, 2012

REFERENCES

1. Varghese.P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd2014.
2. Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair And Rehabilitation of Concrete Structures, Allied Publishers, 2004.
3. Hand Book on "Repair and Rehabilitation of RCC Buildings"–Director General works CPWD, Govt. of India , New Delhi–2002

19CE11E	FINITE ELEMENT TECHNIQUES	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Develop knowledge on modeling, node, discretization and formulations. (K2)
CO2: Analyse one dimensional problems using FE techniques (K2)
CO3: Analyse two dimensional problems using FE techniques (K2)
CO4: Develop Knowledge on truss analysis using FE techniques (K2)
CO5: Develop Knowledge on Finite element software (K3)

UNITI   INTRODUCTION VARIATIONAL FORMULATION   9

Basic concepts of FEM – Engineering Problems and governing differential equations – Modelling – discretization – Node, Element –different types of elements- Boundary

conditions – Strain-displacement relations – Stress strain relations – Potential energy and equilibrium – Weighted integral and weak formulation – Variational approach – Rayleigh Ritz method.

UNITII   FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS   9
Finite element modeling – Coordinates and shapes functions – Assembly of global stiffness matrix and global load vector – Properties of stiffness matrix and load vector – Finite element equations – Treatment of boundary conditions – Temperature effects.

UNITIII   FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS   9
Plane stress and Plane strain problems – Local –Global transformation - Stiffness matrix – Stress calculation Triangular and Quadratic Elements- Isoparametric formulations –shape functions –stiffness matrix

UNITIV   FINITE ELEMENT ANALYSIS OF TRUSS PROBLEMS   9
Plane trusses – Local –Global transformation - Stiffness matrix – Stress calculations.

UNITV   APPLICATIONS OF FEAIN SOFTWARES   9
Introduction to FEA Software – ANSYS, ABAQUS- Modeling- generation of node numbers -Mesh Generation – Post Processing - Analysis.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Chandrupatla, T.R., and Belegundu, A.D., "Introduction to Finite Element in Engineering", 3rd Edition, Prentice Hall, India, 2003.
2. J.N.Reddy, "An Introduction to Finite Element Method", McGraw-Hill, Intl. Student Edition, 2005.
3. S.S.Rao, "The Finite Element Method in Engineering", Pergaman Press, 2003.

REFERENCES
1. Zienkiewics, "The finite element method, Basic formulation and linear problems", Vol.1, 4th Edition, McGraw-Hill, Book Co1998.
2. C.S.Krishnamoorthy, "Finite element Analysis" Theory and Programming, Tata McGraw Hill, 1995.

19CE12E	**DESIGN OF REINFORCED CONCRETE AND**	**L T P C**
	BRICK MASONRYSTRUCTURES	**3 0 0 3**

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Design the retaining walls. (K3)
   CO2: Design the water tanks. (K3)
   CO3: Design staircase, flat slabs, concrete walls. (K3)
   CO4: Design slabs using yield line theory. (K3)
   CO5: Design brick walls. (K3)

UNITI   RETAINING WALLS   9
Retaining wall – Types – Design and detailing of cantilever and counter fort retaining walls.

UNITII   WATER TANKS   9
Design – Underground rectangular tanks – Domes – Overhead circular and rectangular tanks– Design of staging and foundations.

UNITIII   STAIRCASES, FLAT SLABS, RC WALLS   9
Staircase – Types – Design of staircases (ordinary and doglegged) – Design of flat slabs – Design of Reinforced concrete walls.

UNITIV   YIELD LINE THEORY   9
Application of virtual work method to square, rectangular, circular and triangular slabs.

UNITV   BRICK MASONRY   9
Introduction - Classification of walls -Lateral supports and stability - Effective height of wall and columns - Effective length of walls - design loads, load dispersion, permissible stresses - Design of axially and eccentrically loaded brick walls..

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Unnikrishna Pillai,S., Devdas Menon, "Reinforced Concrete Design", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2009.
2. Dayaratnam, P., "Brick and Reinforced Brick Structures", Oxford & IBH Publishing House, 2006.
3. Varghese, P.C., "Advanced Reinforced Concrete Structures", Prentice Hall of India Private Limited, New Delhi, 2007.

REFERENCES
1. Mallick, D.K. and Gupta A.P., "Reinforced Concrete", Oxford and IBH Publishing Company, 2007
2. Krishna Raju, N., "Design of RC Structures", CBS Publishers and Distributors, Delhi,2006
3. Ram Chandra.N. and Virendra Gehlot, "Limit State Design", Standard Book House,2004.

19CE13E	PRESTRESSED CONCRETE STRUCTURES	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
    CO1: Examine the basics and behavior of prestressed concrete. (K3)
    CO2: Estimate the concepts of Limit state of serviceability. (K3)
    CO3: Estimate the Limit state of strength.(K3)
    CO4: Design of prestressed circular tanks and pipes. (K3)
    CO5: Analyse the prestressed composite structures and continuous beams. (K3)

UNITI ANALYSIS OF STRESSES 9

Basic concepts – Principles of prestressing – Classification and types – Advantages Over ordinary reinforced concrete – Materials required – High strength concrete and high tensile steel – Methods of prestressing – Analysis of sections of stresses by stress concept, strength concept and load balancing concept.

UNIT II LIMIT STATE OF SERVICEABILITY 9

Factors influencing deflections – Calculation of Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Losses in pretensioned and post- tensioned members – Estimation of crack width.

UNITIII LIMIT STATE OF STRENGTH 9

Basic assumptions for calculating flexural stresses – Design of sections of Type 1 and Type II post- tensioned and pretensioned beams – Location of wires in pre-tensioned beams – Design for shear based on IS 1343 Code –Determination of anchorage zone stresses in post-tensioned beams by Magnel'smethod,Guyon's method and IS 1343 code – Design of anchorage zone reinforcement.

UNITIV PSC SPECIAL STRUCTURES 7

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks- Design of Poles and Sleepers.

UNITV COMPOSITE BEAM AND CONTINUOUSBEAMS 11

Types of composite construction – Analysis of stresses – Differential shrinkage – Deflections of composite members –Flexural strength of composite members – Design of Composite sections – Methods of achieving continuity in continuous beams – Analysis of secondary moments – Concordant cable.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, Sixth Edition, 2018.
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Company Private Limited, 2009.
3. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2010.

REFERENCES
1. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990.
2. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay2010.
3. David A.Sheppard, William R. and Philips, Plant Cast precast and prestressed concrete – A design guide, McGraw Hill, New Delhi, 1992.
4. Pasala Dayaratnam, Prestressed Concrete Structures, CBS Publishers & distributors Pvt. Ltd, New Delhi, 2018.

19CE14E   **BASICS OF DYNAMICS AND ASEISMIC DESIGN**   **L T P C**
                                                       3 0 0 3

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

     CO1:Develop knowledge in the simulation and mathematical model development SDOF system (K2)

     CO2: Develop knowledge in the simulation and mathematical model development MDOF system (K2)

     CO3: to understand the fundamentals of seismology. (K2)

     CO4: Identify the various causes and effects of earthquakes on structures (K2)

     CO5: analyze and Design the structures subjected to Seismic loading.(K3)

UNIT I   **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' Alemberts Principles – Effect of damping – Free and forced vibration of damped and undamped structures – Response to harmonic forces and periodic forces.

UNIT II   **MULTIPLE DEGREE OF FREEDOM SYSTEM**   **9**
Formulation of equation of motion for multidegree 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 – Modal superposition methods.

UNIT III   **ELEMENTS OF SEISMOLOGY**   **9**
Elements of Engineering Seismology – Definitions, Introduction to Seismic hazard, Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters.

UNIT IV   **RESPONSE OF STRUCTURES TO EARTHQUAKE**   **9**
Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading – Pinching Effect – Bouchinger Effects – Evaluation of Earthquake forces – IS Code 1893: 2002 – Response Spectra – Lessons learnt from past earthquakes.

UNIT V   **DESIGN METHODOLOGY**   **9**
Causes of damage – Planning considerations/Architectural concept (IS 4326–1993) – Guidelines for Earthquake resistant design – Earthquake resistant design of masonry buildings – Design consideration – Guidelines – Earthquake resistant design of R.C.C. buildings – Lateral load analysis – Design and detailing (IS 13920:1993).

                                            L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 2nd Edition, Pearson Education, 2015.

2. Pankaj Agarwal & Shrikhande, "Earth quake resistant Design of Structures", PHI Learning, 2009.
3. Paz, M., "Structural Dynamics – Theory & Computation", CSB Publishers & Distributors, Shahdara, Delhi, 2004.
4. S.R. Damodarasamyand S . Kavitha , Basics of Structural Dynamics and Aseismic Design, Publisher : PHI (1 December 2009).

REFERENCES
1. Biggs, J.M., "Introduction to Structural Dynamics", McGraw–Hill Book Co., N.Y., 2013
2. Dowrick, D.J., "Earthquake Resistant Design and Risk Reduction", John Wiley & Sons, London, 2011.
3. NPEEE Publications.
4. Jai Krishna, Chandrasekaran.A.R., and Brijesh Chandra, Elements of Earthquake Engineering, South Asia Publishers, 1994.

19CE15E   DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES   L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Analyse the composite section (K3)
   CO2: Design Composite Beams (K3)
   CO3: Design Composite floors (K3)
   CO4: Design Composite Columns (K3)
   CO5: Design Composite Trusses (K3)

UNIT I   INTRODUCTION TO STEEL CONCRETE COMPOSITE STRUCTURES   9
Modular ratio – Transformed section – Composite action – No interaction - Full interaction – Slip calculation -Stress block – Ultimate moment capacity. Provisions of IS: 11384 and Euro Code-4-2004.

UNIT II   COMPOSITE BEAMS   9
Introduction to Composite beams - Ultimate moment behaviour – Types and load transferring mechanism of Shear connectors - Types, merits and behaviour of profiled decking - Design consideration for simply supported and continuous composite beam (with or without profile deck) - Problems.

UNIT III   COMPOSITE FLOORS   9
Introduction of composite floors - Discuss on shear transferring mechanism in profile deck system - Bending resistance of composite slab - Design consideration of composite floor - Design of Composite floor.

UNIT IV   COMPOSITE COLUMNS   9
Introduction to composite columns and its applications - Resistance of encased composite column cross section and infilled composite column cross section under compression -

Design consideration of both encased and infilled composite column under - axial compression, uniaxial bending and biaxial bending – Problems.

UNIT V   COMPOSITE TRUSSES   9
Behaviour and application of composite truss - Design consideration – stud specifications – Load calculation - Design of composite truss.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Johnson R.P., "Composite Structures of Steel and Concrete", volume I, Black well scientific publication, U.K.2018.
2. Narayanan R, "Composite steel structures – Advances, design and construction", Elsevier, Applied science, UK, 2006

REFERENCES
1. Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
2. Owens.G.W and Knowles.P, "Steel Designers Manual", Seventh Edition, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 2011.

19CE16E	ADVANCED STEEL STRUCTURES	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Design Different kinds of structural steel connection (K3)
   CO2: Design complex roof trusses (K3)
   CO3: Design storage structures (K3)
   CO4: Design cold formed steel beams (K3)
   CO5: Design cold formed steel columns (K3)

UNITI   INTRODUCTION TO BEAM COLUMN CONNECTION   9
Beam to beam connection – Beam to column connection – Flexible, Rigid, Semi rigid connection- Shear and Moment Connection

UNIT II   ROOFTRUSSES   9
Load Calculation – Introduction to Tubular trusses – Design of Tubular trusses- Design of Fink and complex space trusses – Pre engineering building techniques.

UNITIII   STORAGE STRUCTURES   9
DesignofSilo–DesignofBunker– AiryandJansen'stheory

UNITIV   COLD FORMED STEEL BEAMS   9
Introduction – Press brake and cold rolling Methods- I801 procedure – flat width ratio – Typesof cross sections – local buckling and lateral buckling - Design of flexural member

UNITV   COLD FORMED STEEL COLUMNS   9

Introduction – Q factor – Column design using IS 801 Procedure – Introduction to Direct Design method- Design of axially compressed column

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Teaching resource for, "Structural Steel Design," Volume 1, 2 & 3, Institute for Steel Development and Growth (INSDAG), 2002.
2. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi,2016
3. Ramachandra.S and Virendra Gehlot, "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi,2016

REFERENCES

1. Handbooks of INSDAG (periodicals)
2. Teaching resource for "Cold formed Steel" Design IITMadras.
3. Wie Wen Yu, Design of Cold Formed Steel Structures, Mc-Graw Hill Book Company, 1996
4. S.K. Duggal, Limit State Design of Steel Structures, Mc-Graw Hill Book Company, 2017

19CE18E   EXPERIMENTAL STRESS ANALYSIS   L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Discuss on various strains measurement methods. (K2)
CO2: Classify the various measuring instruments in experimentation. (K2)
CO3: Relate the concept of photo elasticity in calibration of photoelastic materials. (K2)
CO4: Analyze models based on various methods. (K4)
CO5: Describe the advanced techniques in measurements. (K2)

UNIT I   STRAIN MEASUREMENT METHODS   9

Strain gauges – basic characteristics – mechanical, optical, acoustic, electrical inductance and capacitance, pneumatic types – description and working principles – factors producing strain sensitivity – Gauge construction – temperature compensation – Gauge sensitivities and gauge factors – Strain rosettes –Calculation of principal strains and principal stresses.

UNIT II   MEASURING INSTRUMENTS   9

Linear Variable Differential Transducer – Cathode Ray Oscilloscope – XY Plotter – Digital Data Acquisition System – Hydraulic Jacks – Pressure Jacks – load cells – Proving Rings – Vibration meter – Wind Tunnel – Calibration of Testing Instruments.

UNIT III   PHOTO ELASTICITY   9

Two dimensional photo elasticity – Stress optic law – Polariscope – isoclinic and isochromatic fringes – compensators – Separation techniques – Model materials – Calibration of photo elastic materials.

UNIT IV   MODEL ANALYSIS   9

Model analysis – Direct and Indirect models – laws of structural similitude – choice of scales – Model materials – Limitations of model studies –Buckingham pi theorem –Design of direct and indirect models – Begg"s Deformeter and its applications.

UNIT V   ADVANCED TECHNIQUES   9

Fundamentals of photo elastic coatings – Morie fringe and Brittle coating technique – crack detection techniques – Introduction to stress freezing technique. – Introduction to nondestructive testings – Holography.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Dally and Railey, "Experimental stress analysis", 2003.
2. Richard G Budynas, "Advanced Strength and Applied Stress Analysis", Tata McGraw Hill Publishing company Ltd., New Delhi, 2011

REFERENCES
1. Sadhu Singh, "Experimental stress analysis", Khanna Publishers, New Delhi, 2005.
2. Dove and Adam, "Experimental stress analysis and Motion measurements",1989

19CE19E   NON DESTRUCTIVE TESTING   L T P C
                                                                       3 0 0 3
COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
   CO1: Illustrate the Visual inspection and liquid penetrant testing procedures. (K2)
   CO2: Explain the principles and procedures for ultrasonic and Acoustic emission testing of industrial components. (K2)
   CO3: Compare the principles, procedures and Instrumentation used for non-destructive testing of ferromagnetic materials. (K2)
   CO4: Classify the various sources and detectors used for the thermography and radiography techniques. (K2)
   CO5: Critically appraise the NDT techniques available and select the most appropriate one for a given situation/application.(K3)

UNITI   VISUAL INSPECTION AND LIQUID PENETRANT TESTING   9

Introduction: Comparison of Destructive and Non-Destructive Tests -Conditions for Effective Non- Destructive Testing Visual Inspection:-Optical aids used for visual Inspection - Applications Liquid Penetrant Testing: Physical Principles - Procedure for Penetrant Testing - Penetrant Testing Materials– Penetrant Testing Methods - Water washable and Post - Emulsifiable Method.

UNIT II   ULTRASONIC AND ACOUSTIC EMISSION TESTING   9

Ultrasonic Testing: Principle - Ultrasonic Transducers - Flaw detection equipment-Modes of display- Variables affecting Ultrasonic Test-Pulse echo, through transmission and Angle

Beam Testing- Applications, Advantages and Limitations. Acoustic Emission Testing: Principle – Instrumentation – Advantages, Limitations and applications - Acoustic Emission testing of metal pressure vessels - Fatigue crack detection in Aerospace structures.

UNITIII   MAGNETIC PARTICLE, EDDY CURRENT AND MAGNETIC FLUX LEAKAGE TESTING   9

Magnetic Particle Testing: Principle- magnetizing techniques- Procedure used for testing acomponent– Advantages, Limitations and applications Eddy current Testing: Principles – Instrumentation for Eddy current testing – Inspection of ferromagnetic materials - Pulsed eddy current testing- Applications. Magnetic Flux Leakage (MFL) Testing: Principle- Magnetizing and Demagnetizing methods – MFL sensors – Flaw detection and analysis in ferromagnetic specimen – advantages, Limitations and applications.

UNITIV   THERMOGRAPHY AND RADIO GRAPHY TESTING   9

Thermography: Principle - Detectors and Equipments for active thrermography – heating sources – applications - Thermal imaging for condition monitoring of Industrial Components Radiography: Principle - Electromagnetic radiation sources – Radiographic imaging equipments various inspection techniques - Reading and interpretation of radiographs – safety in industrial radiography.

UNITV   INDUSTRIAL APPLICATIONS OF NON-DESTRUCTIVE TESTING   9

Industrial Applications of Non Destructive Testing: Railways- Nuclear industry – Concrete structures - aircraft and aerospace industries –automotive industries – Fire damaged building - Selection of NDT methods – Codes, standards, specifications and Procedures.

L: 45; TOTAL: 45 PERIODS

TEXT BOOK
1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing", Narosa Publishing House, New Delhi, 2014.

REFERENCES
1. Charles J. Hellier, "Hand Book of Non-Destructive Evaluation", The McGraw-Hill Companies, New York,2012.
2. Prasad J and C.G.K. Nair, "Non-Destructive Test and Evaluation of Materials", Tata McGraw- Hill Publishing Company Limited, New Delhi,2008.
3. V.M. Malhotra and N.J. Carino, "Handbook On Nondestructive Testing on Concrete", Second Edition, CRC Press, New York,2004.

19CE20E   **ADVANCED CONCRETE TECHNOLOGY**   **L T P C**
      3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
    CO1: Explain the manufacturing process of cement and cement compositions (K2)
    CO2: Understand the role of aggregate and chemical admixtures (K2)

CO3: Enumerate behavior and properties of mineral admixtures. (K2)
CO4: Understand the new mix design philosophy and properties of concrete. (K2)
CO5: Demonstrate various durability tests on concrete. (K2)

UNIT I   CEMENT COMPOSITIONS   9
Cement production: detailed manufacturing process and quality control parameters– Cement composition: bogue equations and assumptions for bogue equations – Cement chemistry: heat evolution, evolution of hydration, microstructure of concrete, factor affecting hydration rate, composition of pore solution and C-S-H properties.

UNIT II   AGGREGATES AND CHEMICAL ADMIXTURES   9
Aggregate: availability, challenges, shortage, alternative resources, characteristics affecting concrete properties and interfacial transition zone (ITZ). Chemical admixtures: classifications, normal water reducer, high-range water reducer, mechanism of water reducer, factor affecting compatibility, materials for good compatibility and determination of dosage of superplasticizer for concrete mix.

UNIT III   MINERAL ADMIXTURES   9
Mineral admixtures: classifications (fly ash, silica fume, ground granulated blast furnace slag, rice husk ash and metakaolin) and its chemical compositions, Impact of mineral admixtures on concrete properties, status of supplementary cementitious materials, X-ray diffraction studies and pozzolanic reactions

UNIT IV   NEW MIX DESIGN PHILOSOPHY AND CONCRETE PROPERTIES   9
Concept of Elkem Materials-Mixture Analyzer (EMMA), concept of rheology, use of rheometers, slump-based test, tests for fresh state properties of self-compacting concrete, factor affecting the strength, strength tests

UNIT V   DURABILITY   9
Shrinkage: mechanism and classifications, Creep: mechanism and behavior, causes of sulphate, chloride and corrosion attack on concrete - measuring diffusion coefficient, accelerated carbonation test, rapid chloride penetration test, accelerated chloride migration test

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Mehta, P. K., and Monteiro, P. J. M., 'Concrete: Microstructure, Properties, and Materials,' Fourth Edition (Indian Edition), McGraw Hill, 2014
2. Neville, A. M., 'Properties of Concrete,' Pitman Publishing, Inc., MA, 1981.
3. Shetty M.S., ―Concrete Technologyǁ, S.Chand & Company, New Delhi, 2014.

REFERENCE
1. Hewlett, P. C., Ed., 'Lea's Chemistry of Cement and Concrete,' Fourth Edition, Arnold Publishers, NY, 1998.
2. Bentur, A., Diamond, S., and Berke, N.S., 'Steel Corrosion in Concrete,' E&FN Spon, UK, 1997.
3. Taylor, H. W. F., 'Cement Chemistry,' Academic Press, Inc., San Diego, CA, 1990.

4. Lea, F. M., 'The Chemistry of Cement and Concrete,' Chemical Publishing Company, Inc., New York, 1971.
5. Mindess, S., and Young, J. F., 'Concrete,' Prentice Hall, Inc., NJ, 1981.
6. J.Newman and B. S. Choo, Eds., 'Advanced Concrete Technology', Four Volume Set, Elsevier, 2003

19CE24E   **ENGINEERING GEOLOGY**   **L T P C**
                                                                  3 0 0 3

COURSE OUTCOMES

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

CO1: Illustrate the concepts of geological formations, weathering and plate tectonics which are the reasons of earthquakes.(K2)

CO2: Interpret the physical, mechanical and engineering properties of minerals along with formation of coal and petroleum. (K2)

CO3: Interpret the physical, mechanical and engineering properties of rocks. (K2)

CO4: Outline the importance of geological structures and geological investigations.(K2)

CO5: Explain the importance of geological considerations in civil engineering and also the geological hazards such as earthquakes, landslides and Tsunami. (K2)

UNIT I   GENERAL GEOLOGY   9

Geology in Civil Engineering – Branches of geology – Earth Structures and composition – Elementary knowledge on continental drift and plate technologies. Earth processes – Weathering – Work of rivers, wind and sea and their engineering

UNIT II   MINERALOGY   9

Elementary knowledge on symmetry elements of important crystallographic systems – physical properties of minerals – study of the following rock forming minerals – Quartz family. Feldspar family, Augite, Hornblende, Biotite, Muscovite, Calcite, Garnet – properties, behavior and engineering significance of clay minerals – Fundamentals of process of formation of ore minerals – Coal and petroleum – Their origin and occurrence in India.

UNIT III   PETROLOGY   9

Classification of rocks – distinction between igneous, sedimentary and metamorphic rocks. Description occurrence, engineering properties and distribution of following rocks. Igneous rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt Sedimentary rocks sandstone, Limestone, shale, Conglomerate and Breccia. Metamorphic rocks Quartzite, Marble, Slate, Gniess and Schist.

UNIT IV   STRUCTURAL GEOLOGY AND GEOLOGICAL INVESTIGATIONS   9

Attitude of beds – Outcrops – study of structures – Folds, faults and joints – Their bearing on engineering construction. Introduction to Geological maps-Seismic and Electrical methods for Civil Engineering investigations. Applications for sub-surface investigation and groundwater exploration- Borehole core logging and interpretation- Remote sensing techniques – Interpretation for Civil Engineering projects.

UNIT V GEOLOGICAL CONSIDERATIONS IN CIVIL ENGINEERING AND GEOHAZARDS 9

Geological conditions necessary for construction of Bridges, Dams, Reservoirs, Tunnels, Buildings, Road cuttings- Coastal Protetction-Earthquake – Seismic zones of India, Landslides – causes and mitigation. Tsunami – causes and mitigation.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Varghese, P.C., Engineering Geology for Civil Engineering PHI Learning Private Limited, New Delhi, 2012.
2. Parbin Singh. A Text book of Engineering and General Geology, Katson publishing house, Ludhiana 2009.

REFERENCES

1. F.G.Bell. Fundamentals of Engineering Geology, B.S. Publications. Hyderabad, 2011.
2. N. Chenna Kesavulu. Textbook of Engineering Geology, Macmillan India Ltd., 2009
3. Krynine and Judd, "Engineering Geology and Geotechniques", McGraw-Hill Book Company, 1st Edition 2005.

19CE25E	ROCK ENGINEERING	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Classify the rock based on Index properties (K2)
CO2: Explain the stress strain behavior in rocks (K2)
CO3: Explain the insitu stresses and their measurements in rocks (K2)
CO4: Apply the mechanism of rocks in construction (K3)
CO5: Explain the methods of improvement in rock masses (K2)

UNITI CLASSIFICATION AND INDEX PROPERTIES OF ROCKS 6

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose-Rock mass rating and Q system.

UNITII ROCK STRENGTH AND FAILURE CRITERIA 12

Modes of rock failure – Strength of rock – Laboratory and field measurement of shear, tensile and compressive strength. Stress - stain behaviour of rock under compression and deviator loading– Mohr – Coulomb failure criteria and empirical criteria for failure – Deformability of rock.

UNITIII INITIAL STRESSES AND THEIR MEASUREMENTS 10

Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses– Measurements of in-situ stresses-hydraulic fracturing-over coring method—flat jack method.

UNIT IV APPLICATION OF ROCK MECHANICSIN ENGINEERING 10

Simple engineering application – Underground openings – Rock slopes –Foundations and mining subsidence.

UNITV   ROCK STABILISATION   7

Introduction – Rock support and Rock reinforcement – Principles – Support reaction curves - Shotcreting.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Goodman, P.E. "Introduction to Rock Mechanics", John Wiley and Sons, 1989.
2. Stillborg B., "Professional User Handbook for rock Bolting", Tran Tech Publications, 1996.
3. Ramamurthy. T., "Engineering in Rocks for Slopes, Foundation and Tunnels: (3rdEdition), PHI Learning Private Limited, New Delhi, 2014.
4. Brady, B.H.G. and Brown, E.T., Rock mechanics for underground mining (3rd Edition), Kluwer Academic Publishers, Dordrecht, 2006.

REFERENCES

1. Brown, E.T. "Rock Characterization Testing and Monitoring", Pergaman Press, 1991.
2. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering", Oxford and IBH, 1991.
3. Hook E.and Bray J., Rock slope Engineering, Institute of Mining and Metallurgy", U.K.2004

19CE26E	GROUND IMPROVEMENT TECHNIQUES	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Identify suitable ground improvement techniques based on soil conditions (K3)

CO2: Demonstrate the various dewatering and drainage systems (K2)

CO3: Summarize various insitu treatment of cohesionless and cohesive soils (K2)

CO4: Explain the concept of reinforcement in ground improvement (K2)

CO5: Explain soil stabilization with grouting techniques (K2)

UNIT I   INTRODUCTION   9

Role of ground improvement in foundation engineering - methods of ground improvement – Geotechnical problems in alluvial, laterite and black cotton soils - Selection of suitable ground improvement techniques based on soil condition.

UNIT II   DEWATERING   9

Dewatering Techniques - Well points – Vacuum and electro osmotic methods – Seepage analysis for two dimensional flows for fully and partially penetrated slots in homogeneous deposits – Design for simplecases.

UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVES OILS   10

Insitu densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading

with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

UNIT IV   EARTH REINFORCEMENT   9

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism– Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

UNIT V   GROUTING TECHNIQUES   8

Types of grouts – Grouting equipments and machinery – Injection methods – Grout monitoring Stabilization with cement, lime and chemicals – Stabilization of expansive soil.

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS
1. Bikash Chandra chattopadhyay and Joyanta Maity, "Ground Improvement Techniques", PHI Learning Pvt. Ltd.,2017
2. Purushothama Raj. P, "Ground Improvement Techniques", Firewall Media, 2005.

REFERENCES
1. Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering", McGraw Hill,1994.
2. Koerner, R.M., "Designing with Geosynthetics", 4[th]Edition, Prentice Hall, Jersey, 2012.
3. Moseley, M.P., "Ground Improvement Blockie Academic and Professional", Chapman and Hall, Glasgow,2004
4. Winterkorn, H.F. and Fang, H.Y. "Foundation Engineering Hand Book". Van Nostrand Reinhold, 1994.

19CE27E   INTRODUCTION TO SOIL DYNAMICS AND MACHINE FOUNDATIONS
L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO1: Explain the vibratory motion of elementary systems (K3)

CO2: Illustrate the propagation of waves in different mediums (K2)

CO3: Explain the dynamic properties of soil (K2)

CO4: Design foundations under dynamic loading (K2)

CO5: Interpret vibration isolation with engineering considerations (K3)

UNITI   THEORY OF VIBRATION   9

Nature dynamic loads – Vibrations of single degree freedom system – Free vibrations of spring –mass systems – Forced vibrations – Viscous damping - Transmissibility – Principles of vibration measuring instruments – Effect of Transient and Pulsating loads.

UNIT II WAVE PROPAGATION 9

Elastic waves in rods of infinite length – Longitudinal and Torsional – Effect of end conditions – Longitudinal and torsional vibrations of rods of finite length – Wave Propagation in infinite, homogeneous isotropic and elastic medium - Wave propagation in elastic half space – Typical values of compression wave and shear wave velocity – Wave propagation due to Machine foundation – Surface wave – Typicalvalues – Particle movements and velocity.

UNIT III DYNAMIC PROPERTIES OF SOILS 9

Dynamic stress – Strain characteristics – Principles of measuring dynamic properties – Laboratory Techniques – Field tests – Factors affecting dynamic properties – Typical values – Dynamic bearing capacity – Dynamic earth pressure.

UNIT IV FOUNDATION FOR DIFFERENT TYPES OF MACHINES 9

Types of machines and foundation – General requirements – Modes of vibration of a rigid foundation – Method of analysis – Linear elastic weightless spring method – Elastic half space method – Analog Method – Design of block foundation – Special consideration for rotary, Impact type of machines – Codal Provisions.

UNIT V INFLUENCE OF VIBRATION AND REMEDIATION 9

Mechanism of Liquefaction – Influencing factors – Evaluation of Liquefaction potential based on SPT- Force Isolation – Motion Isolation – Use of spring and damping materials – Vibration control of existing machine foundation – Screening of vibration – Open trenches – Pile Barriers – Salient construction aspects of machine Foundations.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Swamisaran, "Soil Dynamics and Machine Foundations", Galgotia Publications Pvt. Ltd. (Second Edition) 2006, (Reprint 2010), NewDelhi-110002
2. Srinivasulu. P, and Vaidyanathan. C.V, "Handbook of Machine Foundations", Tata McGraw-Hill, 2007

REFERENCES

1. Kamaswara Rao., "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998.
2. Kameswara Rao., "Dynamics Soil Tests and Applications", Wheeler Publishing, New Delhi, 2003.
3. Moore, P.J., "Analysis and Design of Foundation for Vibration", Oxford and IBH,2005
4. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall, 2014.

19CE28E EARTHQUAKE GEOTECHNICAL ENGINEERING L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Identify the causes and mechanism of earthquakes (K2)

CO2: Discuss basic facts of soil behavior under dynamic loading (K2)
CO3: Outline the role of soil deposits in modifying the seismic ground motion (K2)
CO4: Design foundations, slopes and retaining walls using seismic codes (K2)
CO5: Explain the principles of earthquake hazard mitigation measures (K2)

UNIT I   ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS   6
Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory- Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

UNITII   GROUNDMOTION CHARACTERISTICS   10
Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

UNIT III   GROUND RESPONSE ANALYSIS AND DESIGN GROUND MOTION   10
Wave propagation Analysis - Site Amplification, Ground Response Analysis - Method of analysis - One Dimensional Analysis - Equivalent linear Analysis – shear beam Analysis - site effects - Design Ground Motion - Developing Design Ground Motion. Application of software package - codal recommendations.

UNIT IV   SEISMIC STABILITY ANALYSIS   12
Earthquake Resistant Design of foundation of buildings - Design considerations - Geotechnical - Architectural - Structural - Capacity Design - Seismic analysis. Earthquake Response of slopes - Evaluation of slope stability - Pseudostatic Analysis - Newmark's Study of Block Analysis - Dynamic Analysis - Earth pressure due to ground shaking valuation - Lateral Deformation - codal provisions.

UNIT V   EARTHQUAKE HAZARD MITIGATION   7
Seismic risk vulnerability and hazard - Risk mapping - scale – changing percept of risk – vulnerability Atlas of India. Hazard assessment - Maintenance and modifications to improve hazard resistance; Seismic microzonation – methodology – scale of mapping - Different type of foundation and its impact on safety.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. KameswaraRao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing – New Delhi, 2000.
2. Krammer S.L., "Geotechnical Earthquake Engineering", Prentice Hall, International series Pearson Education(Singapore) Pvt. Ltd.,2004.

REFERENCES
1. McGuire, R.K., "Seismic Hazard and Risk Analysis", Earthquake Engineering Research Institute, MNo – 10, ISBN 0-943198-01-1, 2004.
2. Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., "Disaster Management", Narosa Publishing House, New Delhi, India ISBN :81-7319-727X-2006

19CE29E   **EARTH AND EARTH RETAINING STRUCTURES**   **L T P C**
                                                       3 0 0 3

COURSE OUTCOMES

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

     CO1: Analyse the earth pressure acting on retaining structures by applying classical theories. (K2)

     CO2: Apply the knowledge of engineering and earth pressure to analyse and design rigid retaining structures (K3)

     CO3: Apply the knowledge of engineering and earth pressure to analyse and design flexible earth retaining walls and also acquire the knowledge of design of anchors (K3)

     CO4: Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations, slurry supported excavations and underground utilities (K3)

     CO5: Analyse the stability of infinite and finite slopes through total stress and effective stress analysis (K2)

UNIT I   **EARTH PRESSURE THEORIES**   **9**

State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.

UNIT II   **STABILITY OF RETAINING STRUCTURES**   **9**

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

UNIT III   **SHEET PILE WALLS**   **9**

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.

UNIT IV   **SUPPORTED EXCAVATIONS**   **9**

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning – Basic design concepts-Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.

UNIT V   **STABILITY OF SLOPES**   **9**

Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts. Role of geosynthetics in stabilization of slopes.

                                           L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

   1. M. Budhu, "Foundation and Earth Retaining Structures", -Wiley, 2008

2. Braja M Das and Khaled Shoban, "Principles of Geotechnical Engineering"-Cengage Learning-8th edition-2014

REFERENCES
1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
2. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992.
3. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley – Interscience Publication, 1984.
4. Petros P. Xanthakos, Slurry walls as structural systems, McGraw-Hill, Inc., New York, 1994.

19CE30E   GEO ENVIRONMENTAL ENGINEERING   L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Understand the concepts and principles of Geo-environmental Engineering. (K2)
CO2: Understand the mechanism of contaminants transport into the subsurface and characterization of contaminated sites (K2)
CO3: Understand on how to decontaminate the site for the reutilization of site. (K2)
CO4: Understand how to safely dispose the waste through different containment process. (K2)
CO5: Expose on how to convert the waste into a resource material through soil waste stabilization techniques (K2)

UNIT I   SOIL – WASTE INTERACTION   9
Role of Geoenvironmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure - factors influencing soil-pollutant interaction – modification of index, chemical and engineering properties – physical and physio- chemical mechanisms- Environmental laws and regulations.

UNIT II   CONTAMINANT TRANSPORT AND SITE CHARACTERISATION 9
Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation – characterization of contaminated sites – soil and rock data– hydrological and chemical data – analysis and evaluation – risk assessment – case studies.

UNIT III   WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES 9
Insitu containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – soil vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, phyto remediation – ground water remediation – pump and treat ,Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.

UNIT IV   LANDFILLS AND SURFACE IMPOUNDMENTS   9

Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection – final cover design – monitoring landfill.

UNIT V   STABILISATION OF WASTE   9

Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization – case studies..

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Hsai-Yang Fang and Ronald C. Chaney, Introduction to Environmental Geotechnology - CRC Press, Taylor and Francis Group, Second Edition, 2016

REFERENCE

1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
2. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.

19CE31E   REMOTE SENSING TECHNIQUES AND GEOGRAPHIC INFORMATION SYSTEM   L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Explain the basic principles of remote sensing and spectral signatures (K2)
CO2: Classify the types of sensors and image interpretation (K2)
CO3: Illustrate the components of GIS (K2)
CO4: Interpret the data entry, storage and analysis (K2)
CO5: Apply the techniques of Remote Sensing and GIS in Civil Engineering field (K3)

UNITI   EMR AND ITS INTERACTION WITH ATMOSPHERE   9

Remote Sensing – Principle - Electro-magnetic energy, spectrum - EMR interaction with atmosphere– Atmospheric Windows and its Significance – EMR interaction with Earth Surface Materials – Spectral Signature and Spectral Signature curves for water, soil and Earth Surface.

UNITII   SENSORS AND DATA INTERPRETATION   9

Satellites - Classification – Satellite Sensors – satellite and sensor parameters - Resolution – Types of Remote Sensing - Visual Interpretation of Satellite Images – Digital Image processing – Characteristics of different platforms: Airborne and space borne TIR and microwave sensors, High Resolution Sensors - LIDAR, SAR, MODIS and AMSRE.

UNIT III   GEOGRAPHIC INFORMATION SYSTEM   9

GIS - History of Development - Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Data Input Sources– DBMS – Data Output - Data models - Raster and Vector data structures – Data compression – Raster vs Vector comparison.

UNIT IV   GIS DATA INPUT, STORAGE AND ANALYSIS   9

Analysis using Raster and Vector data – Operations – Overlaying - Buffering – Modeling in GIS - Digital Terrain Modeling, Analysis and application – Products of DEMs and their uses – Sources of errors in GIS and their elimination.

UNIT V   APPLICATIONS OF REMOTE SENSING AND GIS   9

Applications of Remote Sensing and GIS – Advanced applications of GIS – Disaster management, Water resource, Land use – Land cover – Urban planning - Intelligent Transport Systems - Development of Resources Information Systems.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas Lillesand, Ralph W.Kiefer, Jonathan Chipman, "Remote Sensing and Image Interpretation", January 2015
2. Anji Reddy, M., "Remote Sensing and Geographical Information System", BS Publications, Hyderabad, 2005.
3. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.

REFERENCES

1. Thomas. M. Lillesand and Ralph.W.Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 2003.
2. Lo. C.P. and A.K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Private Limited, New Delhi, Pp: 492., 2002.
3. Peter A.Burrough, Rachael A. McDonnell, "Principles of GIS", Oxford University Press, 2000.

19CE32E	PAVEMENT ENGINEERING	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Identify the type of pavement and distribution of stress (K2)
CO2: Design the flexible pavement (K3)
CO3: Design the rigid pavement (K3)
CO4: Apply type of maintenance and evaluation procedure of the pavement (K2)
CO5: Identify different methods for stabilization of pavement (K2)

UNIT I   GENERAL PRINCIPLES OF PAVEMENT DESIGN   9

Introduction - Pavement as layered structure - Pavement types – Pavement stability-

Stress and deflections in pavements under repeated loading.

UNIT II   DESIGN OF FLEXIBLE PAVEMENT   9
Empirical– Semi empirical and theoretical Methods – Design procedure as per latest IRC guidelines - Design and specification of rural road.

UNIT III   DESIGN OFRIGID PAVEMENT   9
Cement concrete pavements - Modified Westergard approach - Design procedure as per latest IRC guidelines - Joints in rigid pavements - Concrete roads and their scope in India.

UNIT IV   PERFORMANCE EVALUATION AND MAINTENANCE   9
Pavement Evaluation [Condition and evaluation surveys] - Structural Evaluation by Deflection Measurements, Present Serviceability Index] – Strengthening of Pavement - Pavement maintenance. [IRC Recommendations Only]

UNIT V   STABILISATION OF PAVEMENTS   9
Stabilisation with special reference to highway pavements - Choice of stabilizers -Testing and field control – Stabilisation for rural roads in India - Geosynthetics (geotextiles & Geogrids) in roads.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, "Highway Engineering", New Chand and Brothers, Revised 10th Edition, 2014.
2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna Tech. Publications, New Delhi, 2005.
3. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi,2001

REFERENCES
1. Yoder R.J and Witczak M.W., "Principles of Pavement Design", John Wiley, 2000.
2. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2012, The Indian roads Congress, New Delhi.
3. Guideline for the Design of Plain jointed Rigid Pavements for Highways, IRC: 58- 2002, the Indian Roads Congress, New Delhi.

**19CE33E   TRAFFIC ENGINEERING AND MANAGEMENT   L T P C
                                                            3 0 0 3**

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
    CO 1: Explain the fundamental characteristics of road, traffic and land use (K2)
    CO 2: Apply appropriate techniques of traffic surveys and analysis (K3)
    CO 3: Design various methods of traffic control measures (K2)
    CO 4: Design elements of traffic intersections (K2)
    CO 5: Summarize various methods of traffic management (K2)

UNIT I   TRAFFIC CHARACTERISTICS   9
Significance and scope – Road Characteristics – Road user characteristics – PIEV theory–

Vehicle– Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India

UNIT II   TRAFFIC SURVEYSANDANALYSIS   9
Traffic Survey and analysis – Traffic Volume Survey – Methods and interpretation, Speed and Delays, Origin and Destination– Methods and Presentation, Parking and Pedestrian studies– Methods and interpretation, Accident studies and safety- level of services.

UNIT III   TRAFFIC CONTROL   9
Traffic signs and road markings - design of traffic signals and signal co-ordination - traffic control aids and street furniture – Networking pedestrian facilities & cycletracks.

UNITIV   GEOMETRIC DESIGN OF INTERSECTIONS   9
Conflicts at intersections - classification of„at grade‟ intersections - channelized intersections - principles of intersection design - elements of intersection design - rotary design - grade separation and interchanges -design principles.

UNITV   TRAFFIC MANAGEMENT   9
Traffic management - transportation system management (TSM) - travel demand management (TDM) - traffic forecasting techniques - one way streets-traffic segregation - traffic calming - exclusive bus lanes - Intelligent Transportation System (ITS).

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS
1. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2014.
2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2000.
3. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013

REFERENCES
1. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management.
2. Guidelines of Ministry of Road Transport and Highways, Government of India.
3. Subhash C.Saxena, A Course in Traffic Planning and Design, Dhanpat Rai Publications, New Delhi, 1989.
4. Transportation Engineering – An Introduction, C.JotinKhisty, B.KentLall, Prentice Hall of India Pvt. Ltd, 2006.

19CE34E   RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING   L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Explain the components of railways, their functions and its geometric design (K2)

CO2: Explain construction and maintenance of railway track (K2)
CO3: Illustrate the concepts of Airport planning and layout (K2)
CO4: Understand the airport design, visual aids, and air traffic control (K2)
CO5: Summarize various components of harbour, its function and layout (K2)

UNIT I   RAILWAY PLANNING AND DESIGN   10

Role of Indian Railways in National Development – LRT & MRTS - Engineering Surveys for Track Alignment – Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments) - Permanent Way, its Components and their Functions: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps in rails and defects in Rails -Sleepers – Functions, Materials, Ballast – Functions, Materials, Ballastless Tracks - Geometric Design of Railway – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

UNIT II   RAILWAY CONSTRUCTION AND MAINTENANCE   9

Design of Turnouts, Working Principle - Track Drainage and ventilation - Track Modernisation - Construction & Maintenance of tracks, Re-laying of Track, Signalling, Interlocking and Track Circuiting - Lay outs of Railway Stations and Yards, Level crossings.

UNIT III   AIRPORT PLANNING   8

Role of Air Transport, airport classification, Airport Planning – Objectives, components, typical airport layout – Apron, Terminal Building, Hangars, Motor Vehicle Parking Area and Circulation Pattern, Case studies of Airport Layouts, Site Selection and Airport Drainage.

UNIT IV   AIRPORT DESIGN   9

Runway Design- Orientation, Cross wind Component, Wind rose Diagram (Problems), Geometric Design and Corrections for Gradients (Problems), Taxiway Design – Geometric Design Elements, Minimum Separation Distances, Design Speed, Visual Aids – Runway and Taxiway Markings, Wind Direction Indicators, Runway and Taxiway Lightings - Air Traffic Control.

UNIT V   HARBOUR ENGINEERING   9

Natural phenomena of harbour - Requirements and Classification of Harbour – Ports and its classification – Layout of harbour -Site Selection & Selection Investigation – Dry and Wet Docks, Planning and Layouts – Port Buildings, Warehouse, Transit Sheds, Intermodal Transfer Facilities, Mooring Accessories, Navigational Aids-Coastal Structures - Coastal Shipping, Inland Water Transport and Container Transportation.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS
1. Saxena Subhash C and Satyapal Arora, A Course in Railway Engineering, Dhanpat Rai and Sons, Delhi,1998.
2. Khanna S K, Arora M G and Jain S S, Airport Planning and Design, NemchandandBrothers, Roorkee, 2012.

3. S P Bindra, A Course in Docks and Harbour Engineering, Dhanpat Rai and Sons, New Delhi, 2013.

REFERENCES

1. Rangwala, Railway Engineering, Charotar Publishing House, 2013.
2. Rangwala, Airport Engineering, Charotar Publishing House, 2013.
3. Oza.H.P. and Oza.G.H., "A course in Docks & Harbour Engineering", Charotar Publishing Co. 2013.
4. J.S. Mundrey, "A course in Railway Track Engineering". Tata McGraw Hill, 2007.

19CE35E	ADVANCED SURVEYING	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Apply total station and EDM in distance measurement and traversing design (K3)
CO2: Explain the photogrammetric surveying and do the photo interpretation (K2)
CO3: Explain the basic concepts of remote sensing(K2)
CO4: Apply GPS in transportation engineering and land use planning (K3)
CO5: Understand the route surveys and tunnel alignments (K2)

UNIT I   EDM AND TOTAL STATION   9

Electromagnetic distance measurement (EDM) – Principle of EDM Carrier waves – Types of EDM instruments – Distomat – Total Station – Principle – procedure & surveying using Total Station – precise leveling - Micro-optic theodolite.

UNITII   PHOTO GRAMMETRY   9

Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera - Geometry and scale of vertical photographs – Ground co-ordinates from vertical photographs - Relief displacement – Planimetric mapping from vertical photos – Stereoscopy– Photo interpretation Drone surveying.

UNITIII   REMOTE SENSING   9

Remote sensing – concepts – Idealized remote sensing system – characteristics – Types of remote sensing system – Remote sensing from space – Data interpretation – application of remote sensing - LIDAR – RADAR -SONAR.

UNITIV   GPS SURVEYING   9

GPS Basics – system overview – working principle of GPS – Satellite ranging –calculating position – Ranging errors and its correction – GPS surveying Methods – static, Rapid static, DGPS and Kinematic methods – Real time and post processing DGPS – visibility diagram – GAGAN – Geofencing.

UNITV   MISCELLANEOUS   9

Reconnaissance – Route surveys for highways, railways and waterways – simple,

compound, reverse, transition and vertical curve – setting out methods - hydrographic surveying – tides – MSL – Sounding methods – measurement of current and discharge – Tunnel alignment and setting out – Settlement and Deformation studies.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Duggal, S.K. Surveying Vol. II, Tata McGraw Hill, 2004.
2. Punmia, B.C. Surveying Vol.III, Standard Publishers, 2005.
3. Arora, K. R. Surveying Vol. III, Standard Book House,1996.

REFERENCES

1. James M.Anderson and Edward M.Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2001.
2. Bannister and S.Raymond, "Surveying", 7[th]Edition, Longman, 2004.
3. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
4. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.

19CE36E	HIGHWAY TRAFFIC ANALYSIS AND DESIGN	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO1: Understand various elements of traffic engineering. (K2)
CO2: Apply the knowledge about various studies to evaluate traffic volume. (K3)
CO3: Understand the various traffic elements. (K2)
CO4: Apply various traffic design considerations and its control provisions. (K3)
CO5: Understand various additional facilities of traffic design and road safety measures. (K2)

UNIT I   INTRODUCTION   9
Elements of Traffic Engineering – road user, vehicle and road way – Vehicle characteristics – IRC standards – Design speed, volume – Highway capacity and levels of service – capacity of urban and rural roads – PCU concept and its limitations – Road user facilities – Parking facilities – Cycle tracks and cycleway.

UNIT II   TRAFFIC ANALYSIS   9
Traffic volume studies – origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies.

UNIT III   TRAFFIC ELEMENTS   9
Elements of design – Alignment – Cross sectional elements – Stopping and passing sight distance – Horizontal curves – Vertical curves – Design problems – Hill Roads.

UNIT IV   TRAFFIC DESIGN   9

Traffic regulation and control – Signs and markings – Traffic System Management – Design of at-grade intersections – Principles of design – Channelization – Design of rotaries – Traffic signals – pre-timed and traffic actuated – Design of signal setting – phase diagrams timing diagram – Signal co-ordination.

UNIT V HIGHWAY FACILITIES AND SAFETY 9
Grade separated intersections – Geometric elements for divided and access controlled highways and expressways – Road furniture – Street lighting – Traffic Safety – Principles and Practices – Road Safety Audit.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Saxena S C, "Textbook of Highway and Traffic Engineering", CBS Publishers, 2020.
2. Yang Xiaoguang, "Traffic Design," S.K. Kataria & Sons, 2014.

REFERENCES
1. ITE Hand Book, "Highway Engineering Hand Book", Mc Graw - Hill.
2. AASHTO A Policy on Geometric Design of Highway and Streets.

19CE37E	TRANSPORTATION PLANNING	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
CO1: Understand the basics of transportation planning. (K2)
CO2: Understand the process involved in transportation planning. (K2)
CO3: Apply the knowledge about traffic assignment models. (K2)
CO4: Apply the traffic land use concepts to solve planning problems. (K3)
CO5: Apply the concepts of transportation planning for its implementation. (K3)

UNIT I INTRODUCTION 9
Urban Transportation Planning – Goals and objectives – Hierarchical levels of transportation planning – Forecast – Implementation – Constraints – UTP survey – Inventory of land use.

UNIT II TRANSPORTATION PLANNING PROCESS 9
Trip generation – Trip classification – productions and attractions – Multiple regression models – Category analysis – Trip production models – Trip distribution models – Linear programming approach.

UNIT III TRAFFIC ASSIGNMENT 9
Modal split models – Behavioural models – Probabilistic models – Utility functions – logit models – Two stage model – Traffic assignment – Assignment methods – Route-choice behaviour – Network analysis.

UNIT IV TRAFFIC LAND USE CONCEPTS 9

Land use and its interaction – Lowry derivative models – Quick response techniques – Non-Transport solutions for transport problems – Characteristics of urban structure – Town planning concepts.

UNIT V TRANSPORTATION PLAN PREPARATION 9

Preparation of alternative plans – Evaluation techniques – Plan implementation – Monitoring – Financing of Project – Case studies.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Joshi G J, Pradip Kumar Sarkar, Vinay Maitri, "Transportation Planning: Principles, Practices and Policies", PHI Learning, 2022.
2. Asheesh Kumar, "Transportation System and Planning," Vayu Education of India, New Delhi, 2012.

REFERENCES
1. Hutchinson, B.G., "Principles of Urban Transport Systems Planning", Scripta, McGraw-Hill, NewYork, 1974.
2. Khisty C.J., "Transportation Engineering - An Introduction", Prentice Hall, India, 2002.

19CE38E   **ENVIRONMENTALIMPACTASSESSMENT**   **L T P C**
                                                                              3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO1: Interpret the fundamentals and need for Environmental Impact Assessment (K2)
   CO2: Carry out screening and scoping of developmental projects and to understand different methodologies of EIA (K2)
   CO3: Plan environmental impact assessments and environmental management plans (K2)
   CO4: Assess socioeconomic investigation of the environment in a project (K3)
   CO5: Acquire knowledge to prepare environmental impact assessment reports (K3)

UNIT I INTRODUCTION TO EIA 8
Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types EIA in project cycle –EIA Notification and Legal Framework in India – components of EIA Stakeholders and their Role in EIA

UNIT II ENVIRONMENTAL ASSESSMENT AND METHODOLOGY 10
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 – Checklist Methods - overlay - Analysis of alternatives

UNIT III ENVIRONMENTAL MANAGEMENT PLAN 9
Plan for mitigation of adverse impacts on various environmental matrices - Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Environmental Clearance – preparation and implementation - Post Project Audit

UNIT IV   SOCIO ECONOMIC ASSESSMENT   10

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis- Public Consultation

UNIT V   CASE STUDIES   8

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 - Waste Processing and Disposal facilities Mining Projects.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Canter, R.L. Environmental impact Assessment, 2ndEdition, McGraw Hill Inc., New Delhi, 1995
2. Peter Morris, RikiTherivel, "Methods of Environmental Impact Assessment", Rout ledge Publisher, 2009

REFERENCES

1. Ministry of Environment and Forests, EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010
2. "Environmental Assessment Source book", Vol. I, II & III, The World Bank, Washington, D.C., 1991.

19CE39E	INDUSTRIAL WASTE MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Summarize the types, characteristics and effects of industrial waste in environment (K2)

CO2: Outline the concepts of Pollution prevention (K2)

CO3: Explain the various treatment technologies of waste from major industries (K2)

CO4: Discuss options for wastewater reuse & residue management (K2)

CO5: Identify technologies on management of hazardous waste (K3)

UNIT I   INTRODUCTION   9

Types of industries and industrial pollution – Industrial scenario in India – Regulatory requirements for treatment of industrial wastewater, industrial waste survey, industrial wastewater generation rates, characterization and variables, population equivalent, Bioassay studies – effects of industrial effluents on streams, land, sewage treatment plants and human health.

UNIT II   INDUSTRIAL POLLUTION PREVENTION   9

Prevention Vs Control of industrial pollution – benefits and barriers. Source reduction techniques – waste audit, evaluation of pollution prevention options, environmental statement as a tool for pollution prevention, waste minimization circles.

UNIT III   INDUSTRIAL WASTEWATER TREATMENT   9

Equalization – neutralization, oil separation, flotation, precipitation, Aerobic and anaerobic biological treatment – Advanced Chemical oxidation – Electro chemical oxidation, wet air oxidation, ozonation, photocatalysis – Heavy metal removal, Refractory organics separation by adsorption – Individual and common effluent treatment plants – combined treatment of industrial waste water and municipal wastewater**.**

UNIT IV   WASTEWATER REUSE AND RESIDUAL MANAGEMENT   9

Evaporation – Evaporators types and classification – Zero Liquid discharge systems – Quality requirements for wastewater reuse, industrial reuse, disposal on water and land – Residuals from industrial wastewater treatment units - quantification and characteristics of sludge – thickening, digestion, conditioning, dewatering and disposal of sludge. Management of RO rejects.

UNIT V   CASE STUDIES AND HAZARDOUS WASTE MANAGEMENT   9

Industrial manufacturing process description, waste water characteristics, source reduction options and waste treatment flow sheet for textiles, tanneries, pulp and paper, metal finishing, sugar and distilleries. Hazardous wastes - Physico chemical treatment – solidification – incineration – Secure land fills.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. W.W.Eckenfelder Jr., "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi, 2000
2. M.N.Rao & A.K.Dutta, "Wastewater Treatment", Oxford - IBH Publication, 1995.

REFERENCES

1. T.T.Shen, "Industrial Pollution Prevention", Springer, 1999.
2. R.L.Stephenson and J.B.Blackburn, Jr., "Industrial Wastewater Systems Hand book", Lewis Publisher, New York,1998
3. Paul L. Bishop "Pollution Prevention: - Fundamentals and Practice", McGraw – Hill International, 2000.

19CE40E	ECOLOGICAL ENGINEERING	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Explain the concept of ecosystem (K2)
CO2: Infer the function of ecosystem and its biochemical reaction (K2)
CO3: Make use of rehabilitation methods for the treatment of ecosystem (K3)
CO4: Outline the effects due to industrialization and its case studies (K2)
CO5: Understand the need for sustainability (K2)

UNIT I   PRINCIPLES AND CONCEPTS   9

Scope and applications of Ecological Engineering – Development and evolution of ecosystems – Principles and concepts pertaining to species, populations and community

UNIT II   ECOSYSTEM FUNCTIONS   9

Biological magnification, diversity and stability, immature and mature systems - Primary productivity – Biochemical cycling of nitrogen, phosphorous, sulphur and carbon dioxide – Habitat ecology - Terrestrial, fresh water, estuarine and marine habitats.

UNIT III   ECOLOGICAL ENGINEERING METHODS   10

Bio monitoring and its role in evaluation of aquatic ecosystem; Rehabilitation of ecosystems through ecological principles – Step cropping, bio-wind screens, Wetlands, ponds, Root Zone Treatment for wastewater, Reuse of treated wastewater through ecological systems – Green building and Bio mimicry.

UNIT IV   ECOLOGICAL EFFECTS OF INDUSTRIALISATION   8

Ecological effects of exploration, production, extraction, processing, manufacture & transport.

UNIT V   CASE STUDIES AND ENVIRONMENTAL SUSTAINABILITY   9

Case studies of integrated ecological engineering systems – Planning, Measuring Sustainability – Carrying Capacity and its limits – Concept of Ecological Foot print.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Odum, E.P., "Fundamental of Ecology", W.B.Sauders,1990.
2. Kormondy, E.J., "Concepts of Ecology", Prentice Hall, New Delhi,1996

REFERENCES

1. Mitch, J.W. and Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley and Sons, 1996.
2. Colinvaux, P., Ecology, John Wiley and Sons, 1996.
3. Etnier, C &Guterstam, B., "Ecological Engineering for Wastewater Treatment", 2nd Edition, Lewis Publications, London, 1996.

19CE41E	ENVIRONMENTAL INSTRUMENTATION	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Discuss the fundamental blocks of Measurement system (K2)

CO2: Explain the working and list the types of sensor and transducer (K2)

CO3: Explain the causes and effects of water, air and noise pollution on environment (K2)

CO4: Describe the working principle of instruments for quality of water, air and sound monitoring and measurement (K2)

CO5: Select the appropriate instrument for specific application and environmental monitoring and measurement and control (K2)

UNIT I   INTRODUCTION   9

Definition: Measurement and Instrumentation, Block diagram of Measurement system – Types of Sensor and Transducer. Necessity of instrumentation & control for environment, sensor requirement for environment.

UNIT II   WATER   9

Definitions, causes and effects of water pollution. Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality measurement: Thermal conductivity detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application.

UNIT III   GROUND AND WASTEWATER   9

Level measurement in wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution. Automatic waste water sampling, optimum waste water sampling locations. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Quality assurance of storage water.

UNIT IV   AIR   9

Definitions, causes and effects of air pollution, air pollution from thermal power plant. Air sampling methods &equipment's, analytical methods for air pollution studies. Measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement.

UNIT V   SOUND   9

Definitions, causes and effects of Noise Pollution and Its Monitoring. Ambient noise, Noise intrusions, impulsive noise, transient noise, airport noise. Sound level meters. Tape recorders, noise dosimeters, sound level monitors and acoustical calibrators. Field equipment's for noise measurement.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Measurement Systems 6th Edition, E.O.Doebelin, Dhanesh N Manik, TMcGH,2011
2. Environmental Instrumentation and Analysis Handbook, Randy D Down, Jay H Lehr, John Wiley & Sons,2005.
3. Instrumentation for Studying Vegetation Canopies for Remote Sensing in Optical and Thermal Infrared Regions, Narendra S. Goel, John M. Norman, Taylor & Francis,1990.

REFERENCES
1. A course manual: Instrumentation in Environmental Engg. NEERI Publications. Nagpur.
2. Handbook of Analytical Instruments, 2ndEdition, R.S. Khandpur, TMcGH, 2007.

19CE42E   **SOIL POLLUTION ENGINEERING**   **L T P C**
                                                             3 0 0 3

COURSE OUTCOMES

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

    CO1: Understand the basic concepts of soil pollution (K2)

    CO2: Understand the regulatory framework and reclamation issues (K2)

    CO3: summarize the top soil management (K2)

    CO4: estimate the carbon sequestration rate (K3)

    CO5: understand the remediation of Mines (K2)

UNIT I   BASIC CONCEPTS OF SOIL POLLUTION   9

Soil pollution: anthropogenic sources; pollutants (metals & organic); pedogenesis, impacts on physical, chemical, nutritional and biological characteristics; effects on ecosystem services, Remediation of soil pollution using Electrokinentic method

UNIT II   REGULATORY FRAMEWORK AND GUIDELINES   9

Importance of land reclamation, rehabilitation, ecological Restoration (ER); National & International practices (SERI guidelines), principles of ER, theoretical foundation of ER. Regulatory framework of ER. Evaluation of restoration success and indicator parameters. Mine pit limnology - formation, hydrology, chemistry, optimum depth; ecology. Engineering reclamation: Issues, site preparation; drainage and erosion control; estimation of soil erosion – USLE & RUSLE, diversion ditch; Design of sedimentation ponds. Reclamation equipment and cost

UNIT III   TOP SOIL MANAGEMENT   9

Topsoil management: Importance, properties; process-inventory, removal, storage, reuse. shelf life of topsoil. Process of increasing soil fertility by innovative approaches - mulches, coir matting, soil amendments, superabsorbent, biofertilizer – VAM fungi. Grass-legume mixture: importance, planting procedure; Hydroseeding. Seeds – treatment & testing. Vegetation establishment & selection of plant species: Cover development technique; Miwayanki methods. Management & aftercare of restored site

UNIT IV   CARBON SEQUESTRATION   9

Carbon sequestration (CS): Types of carbon in RMS; Biomass carbon, estimation of CS rate; soil respiration, Ecosystem C pool. Biodiversity management during mine closure. Ecosystem services, valuation of ecosystem goods & services, calculation of NPV and IRR

UNIT V   MINE MANAGEMENT   9

Mine Tailings Management: Reclamation of tailings impoundments etc. Current bioremediation practice and application.

L: 45, TOTAL: 45 PERIODS

TEXT BOOK

1. Quarry Reclamation - NJ Coppin & AD.Bradshaw, Mining Journal Books, London (1982)

REFERENCES
1. Ecorestoration of the Coalmine degraded lands - Subodh Kumar Maiti, SPRINGER (2013).
2. Lyle ES (Jr) Surface mining reclamation manual, Elsevier, NY (1987).
3. Soil pollution a reality – FAO, United Nation, Rome (2018).

19CE43E   CLIMATE CHANGE AND ADAPTATION   L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: understand the earth's climate system (K2)
CO2: understand the components of atmosphere (K2)
CO3: summarize the impacts of climate change (K2)
CO4: outline the resolutions made to mitigate the climate change (K2)
CO5: understand the remediation of Mines (K2)

UNIT I   EARTH'S CLIMATE SYSTEM   9

Role of ozone in environment - ozone layer - ozone depleting gases - Green House Effect, Radiative effects of Greenhouse Gases - Hydrological Cycle - Green House Gases and Global Warming – Carbon Cycle.

UNIT II   ATMOSPHERE AND ITS COMPONENTS   9

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability - Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.

UNIT III   IMPACTS OF CLIMATE CHANGE   9

Causes of Climate change : Change of Temperature in the environment - Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem– Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV   OBSERVED CHANGES AND ITS CAUSES   9

Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC– IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .

UNIT V   CLIMATE CHANGE AND MITIGATION MEASURES   9

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding 78 Key Mitigation Technologies and Practices – Energy Supply –

Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW& Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
  1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

REFERENCES
  1. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge, 2006.
  2. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
  3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

19CE44E	HAZARDOUS WASTE MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
  CO1: Understand the basic terms and definitions of hazardous waste (K2)
  CO2: apply the appropriate technique to manage hazardous waste (K3)
  CO3: apply the suitable technique to manage and dispose the biomedical waste (K3)
  CO4: apply the suitable technique to manage and dispose the radioactive waste (K3)
  CO5: apply the suitable technique to dispose the E- waste (K3)

UNIT I   INTRODUCTION   9
Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances.

UNIT II   HAZARDOUS WASTES MANAGEMENT   9
Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification-Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.

UNIT III   BIOMEDICAL WASTE MANAGEMENT   9
Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection - , disposal. Infection control Practices.

UNIT IV   RADIOACTIVE WASTE MANAGEMENT   9

Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.

UNIT V   E-WASTE MANAGEMENT   9

Regulatory aspects of E-I Waste management, Waste characteristics – Generation –- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Hazardous Waste Management Charles A.Wentz. Second Edition,1995. McGraw Hill International.
2. Hazardous waste management Michael D. La Gerga, Philip L Buckingham, Jeffrey C. Evans, Second Edition, 2010.Waveland Press.
3. Criteria for hazardous waste landfills–CPCBguidelines2000

REFERENCES

1. Basic Hazardous waste management, "William C.Blackman.Jr", Third Edition, 2001, Lewis Publishers,
2. Integrated solidwaste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.
3. Criteria for hazardous waste landfills–CPCB guidelines 2000.

19CE45E	HYDROLOGY	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Understand the Hydrological process and estimate the rainfall (K2)
CO2: Relate the process of precipitation and evaporation and its measurements (K2)
CO3: Understand the concept of hydrographs (K3)
CO4: Explain the measures of flood control and flood routing (K3)
CO5: Apply the concepts of ground water (K3)

UNIT I   INTRODUCTION ABOUT PRECIPITATION   10

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. Weather and hydrology – General circulation Temperature humidity – Wind – Diurnal and monsonic wind systems.

UNIT II   ABSTRACTION FROM PRECIPITATION AND EVAPORATION   9

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall - Infiltration factors affecting evaporation – Measurement of evaporation.

UNIT III   HYDROGRAPHS   8

Factors affecting Hydrograph – Base flow 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–Floodcontrol–Storm

UNIT V   GROUNDWATER HYDROLOGY   9

Origin- Classification and types - properties of aquifers- governing equations –- Recuperation test – Transmissibility – Specific capacity – Pumping test- Steady flow analysis only- artificial recharge.

<div align="right">

L: 45; TOTAL: 45 PERIODS

</div>

TEXT BOOKS

1. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Publishing Company, Limited,2000
2. JayaramyReddy.P., "Hydrology", Tata McGraw-Hill Publications Private Limited, New Delhi, 2003.

REFERENCES

1. Chow, V.T. and Maidment, "Hydrology for Engineers", McGraw-Hill Inc., Limited,2000
2. Singh, V.P., "Hydrology", McGraw-Hill Inc., Limited,2000.
3. Santosh Kumar Garg, "Hydrology and Water Resources Engineering", Khanna Publications Private Limited, New Delhi,2009.

19CE46E   GROUNDWATER ENGINEERING   L T P C
**   3 0 0 3**

COURSE OUTCOMES

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

CO1: Classify the various modes of ground water distribution (K2)
CO2: Interpret hydraulics of flow in ground water (K2)
CO3: Estimate the ground water parameter (K3)
CO4: Summarize the various ground water development techniques.(K2)
CO5: Describe various water quality parameters. (K2)

UNIT I   FUNDAMENTALS OF GROUND WATER   10

Introduction – Characteristic of Ground water – Distribution of water - ground water column – Permeability - Darcy's Law - Types of aquifers - Hydro geological Cycle – water level fluctuations.

UNIT II   HYDRAULICSOF FLOW   9

Storage coefficient - Specific field - Heterogeneity and Anisotropy -Transmissivity - Governing equations of ground water flow - Steady state flow – DupuitForchheimer assumptions - Velocity potential - Flow nets.

UNIT III   WELL HYDRAULICS   8

Transmissivity and Storativity – Pumping test - Unsteady state flow - Thiess method - Jacob method - Image well theory – Effect of partial penetrations of wells - Collectors wells.

UNIT IV   GROUNDWATER DEVELOPMENT   9

Zoning of water – over exploited, critical, semi critical and safe-Infiltration gallery - Conjunctive use - Artificial recharge Rainwater harvesting - Safe yield - Yield test – Geophysical methods – Selection of pumps.

UNIT V   GROUNDWATER QUALITY   9

Ground water chemistry - Origin, movement and quality - Water quality standards - Saltwater intrusion – Environmental concern.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Raghunath H.M., "Ground Water Hydrology", Wiley Eastern Limited,2000.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons,2000.

REFERENCES
1. C Walton, "Ground Water Resource Evaluation", McGraw-Hill Publications,1998.
2. William C.Walton, "Ground water Engineering", Lewis Publisher,1991.

19CE47E	COASTAL ZONE MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
CO1: Learn various coastal processes and marine ecosystem. (K2)
CO2: Interpret the coastal resources (K2)
CO3: Explain various terms involved in wave dynamics and methods of wave forecasting (K2)
CO4: Summarize effect of tides on structure (K2)
CO5: Understand the coastal regulations, its laws and policies (K2)

UNIT   I   COASTAL ZONE AND ECOSYSTEM   9

Coastal zone – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Marine ecosystem: Mangroves – Sea grass – seaweeds – coral reef – Large marine ecosystem – Climate effects on living marine resources – Biological monitoring of marine ecosystem – Human impacts on marine ecosystem.

UNIT II   COASTAL RESOURCES   8

Types and functions of coastal and marine resources – Renewable and Non-Renewable resources – living marine resources and Non-living marine resources – Marine minerals – placer deposits – hydrocarbon deposits – polymetallicnodules.

UNIT III   WAVE DYNAMICS AND FORECASTING   10

Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves– Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles. Need for forecasting – SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – Seiches – Surges and Tsunamis.

UNIT IV   COASTAL PROCESSES   9

Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.

UNIT V   COASTAL REGULATIONS   9

Introduction – What is ICM – Developing an ICM framework – Principles – Goals – defining boundaries – Coastal regulations for main land India – coastal regulations for Islands – introduction to Environmental Laws and policies.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Richard Sylvester, "Coastal Engineering, Volume I and II",Elseiner Scientific Publishing Co.,1999
2. Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw-Hill Book Co.,1999

REFERENCES
1. Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York,1993
2. Dwivedi, S.N., Natarajan, R and Ramachandran, S., "Coastal Zone Management in Tamilnadu".

19CE48E   WATER RESOURCES ENGINEERING   L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Outline the water resource planning and water policy (K3)

CO2: Generalize the station network design (K3)

CO3: Infer on water resource needs (K3)

CO4: Discuss on reservoir planning and management (K3)

CO5: Explain about economic analysis (K3)

UNIT I   GENERAL   9

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Economics of water resources planning, physical and socio economicdata – National Water Policy – Collection of meteorological and hydrological data for water resources development.

UNIT II NETWORK DESIGN 9

Hydrologic measurements – Analysis of hydrologic data – Hydrologic station network – Station network design – Statistical techniques in network design.

UNIT III WATER RESOURCE NEEDS 9

Consumptive and non-consumptive water use – Estimation of water requirements for irrigation, for drinking and navigation – Water characteristics and quality – Scope and aims of master plan – Concept of basin as a unit for development – Water budget and development plan.

UNIT IV RESERVOIR PLANNING AND MANAGEMENT 9

Reservoir – Single and multipurpose – Multi objective – Fixation of Storage capacity – Strategies for reservoir operation – Sedimentation of reservoirs – Design flood-levees and flood walls – Channel improvement.

UNIT V ECONOMIC ANALYSIS 9

Estimation of cost and Evaluation of Benefits – Discount rate – Discounting factors – Discounting techniques – Computer Applications.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Linsley.R.K. and Franzini.J.B, "Water Resources Engineering", McGraw-Hill Inc,2000.
2. Douglas J.L. and Lee R.R., "Economics of Water Resources Planning", Tata McGraw-Hill Inc. 2000.
3. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers,1998.

REFERENCES

1. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi,1997.
2. Goodman Alvin S., "Principles of Water Resources Planning", Prentice-Hall,1984.

19CE49E **IRRIGATION ENGINEERING** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Compute the water requirement of crops based on soil conditions. (K2)

CO2: Illustrate on different types of irrigation systems and their performances.(K2)

CO3: Demonstrate the behavior of various irrigation structures and their design Principles. (K2)

CO4: Analyze the concept of seepage through appropriate theories. (K2)

CO5: Evaluate the purpose and function of different types of dams. (K2)

UNIT I CROP WATER REQUIREMENT 9

Irrigation – Need and mode of irrigation – Merits and demerits of irrigation – Crop and crop

Seasons – consumptive use of water – Duty – Factors affecting duty – Irrigation efficiencies –Planning and Development of irrigation projects – Water quality standards for Irrigation.

UNIT II   IRRIGATION METHODS AND WATER MANAGEMENT   9

Canal irrigation – Lift irrigation – Tank irrigation – Flooding methods – Merits and demerits – Sprinkler irrigation – Drip irrigation – Optimum use of water – Need for optimization of water use – Methods for improving canal irrigation management – Water losses – On farm development works

UNIT III   CANAL IRRIGATION   9

Alignment of canals – Classification of canals – Canal falls – Types – Design of vertical drop – Cross drainage works – Types – Canal Head works – Canal regulators – River Training works.

UNIT IV   WEIRS AND TANKS   9

Weirs and Barrage – Classification of weirs – Layout of a diversion head work – component parts – Failure of weirs founded on impervious foundation – Bligh's creep theory – Khosla's theory – Tanks – Isolated tanks and tanks in series – Tank weirs – Types of tank weirs – Tank sluices.

UNIT V   DAMS   9

Dams – Types of dams – Problems in dam construction – Factors governing the selection of particular type of dam – Selection of dam site – Gravity dam – Typical cross section – Forces acting on gravity dam – Earth dam – Types of Earth dam – Causes of failure – Arch dam –Types – Forces acting on arch dam – Spillways–Types.

L: 45; TOTAL: 45PERIODS

TEXT BOOKS
1. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000.
2. Punima B.C. &PandeB.B.Lal, "Irrigation and Water Power Engineering", Laxmi Publishing, New Delhi,2009.
3. Santosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publications Private Limited, New Delhi, 2009.

REFERENCES
1. Dilip Kumar Majumdar, "Irrigation Water Management (Principles & Practices)", Prentice Hall of India Private Limited, 2008.
2. Basak.N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 1999.
3. Sharma R.K, "Irrigation Engineering", S.Chand & Co, 2007.

19CE50E	INTEGRATED WATER RESOURCES MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Describe the context and principles of IWRM; Compare the conventional and integrated Ways of water management.

CO2: Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO3: Apply law and governance in the context of IWRM.

CO4: Discuss the linkages between water-health; develop a HIA framework.

CO5: Analyze how the virtual water concepts pave way to alternate policy options.

UNIT I   CONTEXT FOR IWRM   9

Water as a global issue: key challenges - Definition of IWRM within the broader context of development - Key elements of IWRM - Principles - Paradigm shift in water management - Complexity of the IWRM process - UN World Water Assessment - SDGs.

UNIT II   WATER ECONOMICS   9

Economic view of water issues: economic characteristics of water good and services - JNon-market monetary valuation methods - Water economic instruments - Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III   LEGAL AND REGULATORY SETTINGS   9

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses - International law for groundwater management - World Water Forums - Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV   WATER AND HEALTH WITHIN THE IWRM CONTEXT   9

Links between water and health: options to include water management interventions for health - Health protection and promotion in the context of IWRM - Global burden of Diseases - Health impact assessment of water resources development projects - Case studies.

UNIT V   AGRICULTURE IN THE CONCEPT OF IWRM   9

Water for food production: 'blue' versus 'green' water debate - Water foot print - Virtual water trade for achieving global water and food security -- Irrigation efficiencies, irrigation methods - current water pricing policy- scope to relook pricing.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006

REFERENCES
1. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
3. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

19CE51E   **WATER QUALITY MODELLING**   **L T P C**
                                                                      3 0 0 3
COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Know about the principles of water quality modelling.
   CO2: Understand the pollutant transport phenomena in surface and groundwater.
   CO3: Apply the knowledge of surface water quality modelling to predict the water quality of rivers, lakes and estuary.
   CO4: Predict the groundwater contamination transport.
   CO5: Predict water quality of surface and sub-surface water using numerical solution.

UNIT I   MODELLING INSIGHTS   9
Engineers and Mathematical models-Water quality models – historical development - different types of models-- steps in model development - importance of model building.- calibration and verification of models- finite element, finite difference and finite volume methods.

UNIT II   POLLUTANT TRANSPORT`   9
Transport phenomena – advection, diffusion, dispersion- contamination transport in surface and subsurface water - Simple transport models –steady state and time variable solutions- conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport

UNIT III   SURFACE WATER QUALITY MODELLING   10
Water quality modeling of streams, lakes and estuaries – water quality– model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens and BOD-Streeter Phelp's model for point and distributed sources - modified streeter Phelp's equations. Tropic status assessment.

UNIT IV   GROUNDWATER QUALITY MODELLING   9
Groundwater flow and mass transport of solutes – groundwater quality modelling using numerical methods - degradation of organic compounds in sub surface - prediction of

contaminant transport and particle tracking -seawater intrusion – basic concepts and modelling.

UNIT V WATER QUALITY MODELLING SOFTWARE 8

Exposure to surface water and groundwater quality modelling software's – MIKE 21, WASP, QUAL2E and MODFLOW – demonstration - case studies.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Steven C. Chapra, "Surface Water Quality Modelling", Tata McGraw-Hill Companies, Inc., New Delhi, 2018.
2. "Water Quality Modelling for Rivers and Streams" Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands 2017.

REFERENCES

1. **"**Hydrodynamics and Water Quality**:** Modelling Rivers, Lakes, and Estuaries", Zhen-Gang Ji, John Wiley & Sons, 2018.
2. "Modelling Groundwater Flow and Contaminant Transport By Jacob Bear, A. H.-D. Cheng, Springer Science & Business Media, 2010.
3. "Mathematical Modelling of Groundwater Pollution" Ne-Zheng Sun, Alexander Sun, Springer New York, 2012

19CE52E	HOUSING PLANNING AND MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Outline the basics involved in housing planning (K2)
CO2: Explain the various programs involved in housing (K2)
CO3: Design a housing project (K2)
CO4: Summarize the construction techniques and cost effective materials (K2)
CO5: understand the housing finance and project appraisal (K2)

UNIT I INTRODUCTION TO HOUSING 9

Definition of Basic terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV   CONSTRUCTION TECHNIQUES AND COST- EFFECTIVE MATERIALS   9
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V   HOUSING FINANCE AND PROJECT APPRAISAL   9
Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd.,New Delhi, 1999.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 1997.

REFERENCES
1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 1994.
3. National Housing Policy, 1994, Government of India.

19CE53E	ARCHITECTURE AND TOWN PLANNING	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Infer the basic concepts of architecture (K2)
   CO2: Make use of the rules and layout regulations for site (K3)
   CO3: Make use of the rules and regulations for various types of building (K3)
   CO4: Plan & Orient buildings by considering Indian climatic and environmental condition (K3)
   CO5: Explain the concepts and process of town planning (K2)

UNIT I   ARCHITECTURAL DESIGN   8
Architectural Design – an analysis – integration of function and aesthetics – Introduction to basic elements and principles of design.

UNIT II   SITE PLANNING   9
Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

UNIT III   BUILDING TYPES   12
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   8

Man and environment interaction - Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept

UNIT V   TOWN PLANNING   8

Planning – Definition, concepts and processes - Urban planning standards and zoning regulations - Urban renewal – Conservation – Principles of Landscape design.

L :45; TOTAL : 45 PERIODS

TEXT BOOKS
1. Francis D.K. Ching, "Architecture: Form, Space and Order", 4th Edition, Wiley, 2014
2. Givoni B., "Man Climate and Architecture", Applied Science, Barking ESSEX, 1982.
3. Edward D.Mills, "Planning and Architects Handbook", Butterworth London, 1995.

REFERENCES
1. Gallian B.Arthur and Simon Eisner, "The Urban Pattern – City Planning and Design", CBS Publication, New Delhi, 2003.
2. Margaret Robert, "An Introduction to Town Planning Techniques", Hutchinso London, 1990.

19CE54E	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Recognize the need for total quality management and areas of application of this Management concept (K2)
CO2: Predict the need for customer expectations and employee involvement. (K2)
CO3: Estimate six – sigma and perform benchmarking. (K3)
CO4: Devise methods to use Quality FuctionDevolpment (QFD), failure Mode Effect Analysis (FMEA) and Taguchi"s loss functions. (K2)
CO5: Describe ISO 9000 and Environmental Management System (EMS) standards. (K2)

UNIT I   INTRODUCTION   9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM –- Contributions of Deming, Juran and Crosby – Cost of Quality, Analysis Techniques for Quality Costs - Barriers to TQM.

UNIT II   TQM PRINCIPLES   9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service

Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, - Business Excellence Model-Rajiv Gandhi National Quality Award

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 – Stages, Types

UNIT IV   TQM TOOLS & TECHNIQUES II   9

Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V   QUALITY SYSTEMS   9

Need for ISO 9000 - ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing - QS9000 – ISO14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, 3rd Edition, Indian Reprint 2010.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western Thomson Learning, 2005.

REFERENCE
1. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

19CE55E   ENGINEERING ECONOMICS AND COST ANALYSIS   L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Explain the basics of economics (K2)
   CO2: Compare Demand and Schedule (K2)
   CO3: Explain the basic terms in organization (K2)
   CO4: Explain the basic terms in Financing (K2)
   CO5: Explain the basic terms in Analysis of cost (K3)

UNIT I   BASIC ECONOMICS   9

Definition of economics - Nature and scope of economic science - Nature and scope of

managerial economics - Basic terms and concepts - Goods - Economies of large and small scale - Consumption -Wants characteristics and classification - Law of diminishing marginal utility - relation between economic decision and technical decision.

UNIT II   DEMAND AND SCHEDULE   9

Demand - Demand schedule - Demand curve - Law of demand - Elasticity of demand - Types of elasticity - Factors determining elasticity - Measurement - Its significance - Supply - Supply schedule - Supply curve - Law of supply - Elasticity of supply - Time element in the determination of value - Market price and normal price - Perfect competition - Monopoly - Monopolistic competition.

UNIT III   ORGANISATION   9

Forms of business - Proprietorship - Partnership - Joint stock company - Cooperative organisation - State enterprise - Mixed economy - Money and banking - Banking - Kinds - Commercial banks -Central banking functions - Control of credit - Monetary policy - Credit instrument.

UNIT IV   FINANCING   9

Types of financing - Short term borrowing - Long term borrowing - Internal generation of funds -External commercial borrowings - Assistance from government budgeting support and international finance corporations - analysis of financial statement – Balance Sheet - Profit and Loss account - Funds flow statement.

UNIT V   COST AND BREAK EVEN ANALYSES   7

Types of costing – Traditional costing approach - Activity base costing - Fixed Cost – Variable cost – Marginal cost – Cost Output Relationship In The Short Run And In Long Run – Pricing Practice – Full Cost Pricing – Marginal Cost Pricing – Going Rate Pricing – Bid Pricing – Pricing For A Rate Of Return – Appraising Project Profitability – Internal Rate Of Return – Pay Back Period – Net Present Value – Cost Benefit Analysis – Feasibility Reports – Appraisal Process – Technical Feasibility Economic Feasibility – Financial Feasibility. Break Even Analysis - Basic Assumptions – Break Even Chart – Managerial Uses of Break Even Analysis.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
  1. Dewett K.K. &Varma J.D., Elementary Economic Theory, S Chand & Co., 2006
  2. Sharma JC, "Construction Management and Accounts", Satya Prakashan, New Delhi.

REFERENCES
  1. Barthwal R.R., Industrial Economics - An Introductory Text Book, New Age
  2. Jhingan, M.L., "Micro Economic Theory", Konark Pvt.Ltd.
  3. Khan, M.Y. and Jain, P.K., "Financial Management", McGraw-Hill Publishing Co., Ltd.

19CE56E   **INTELLECTUAL PROPERTY RIGHTS**   **L T P C**
                                                                          3 0 0 3

COURSE OUTCOMES

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

CO1: Create awareness on intellectual property rights (IPR). (K2)
CO2: Explain patents and copyrights. (K2)
CO3: Explain application procedures of IPR. (K2)
CO4: Explain the legislations and policy of IPR. (K2)
CO5: Understand the case studies on IPR (K2)

UNIT I   TYPES OF PROPERTY   9

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (i). Movable Property (ii.) Immovable Propertyand (iii.) Intellectual Property.

UNIT II   PATENTS AND APPLICATION PROCEDURES   9

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark Registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III   INTERNATIONAL PRACTICES   9

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT).

UNIT IV   LEGISLATIONS AND POLICY   9

Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

UNIT V   CASE STUDIES   9

Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trademarks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

L: 45; TOTAL: 45 PERIODS

TEXT BOOK

1. Subbaram N.R. "Handbook of Indian Patent Law and Practice", S.Viswanathan Printers and Publishers Pvt. Ltd., 1998.

REFERENCES

1. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1974.
2. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000.

19CE57E **MANAGEMENT OF IRRIGATION SYSTEMS** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Generalise on suitable irrigation system requirements (K2)
CO2: Explain on irrigation scheduling (K2)
CO3: Summarise on irrigation management system (K2)
CO4: Review the operation of irrigation management (K2)
CO5: Infer the involvement of stake holders in irrigation management systems (K2)

UNIT I **IRRIGATION SYSTEM REQUIREMENTS** **9**

Irrigation systems – Supply and demand of water – Cropping pattern – Crop rotation – Crop diversification – Estimation of total and peak crop water requirements – Effective and dependable rainfall – Irrigation efficiencies.

UNIT II **IRRIGATION SCHEDULING** **9**

Time of irrigation – Critical stages of water need of crops – Criteria for scheduling irrigation – Frequency and interval of irrigation.

UNIT III **MANAGEMENT** **9**

Structural and non-structural strategies in water use and management – Conjunctive use of surface and ground waters – Quality of irrigation water.

UNIT IV **OPERATION** **9**

Operational plans – Main canals, laterals and field channels – Water control and regulating structures – Performance indicators – Case study.

UNIT V **INVOLVEMENT OF STAKE HOLDERS** **9**

Farmer's participation in System operation – Water users associations – Farmer councils – Changing paradigms on irrigation management – Participatory irrigation management.

L 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Dilip Kumar Majumdar, "Irrigation Water Management – Principles and Practice", Prentice Hall of India Pvt. Ltd., New Delhi,2014
2. Hand book on Irrigation Water Requirement, R.T. Gandhi, et. al.,Water Management Division Department of Agriculture, Ministry of Agriculture, New Delhi

REFERENCES

1. Hand Book on Irrigation System Operation Practices, Water Resources Management and Training Project, Technical report No.33, CWC, New Delhi, 1990
2. Maloney, C. and Raju, K.V., "Managing Irrigation Together", Practice and Policy in India, Stage Publication, New Delhi, India, 1994.

19CE58E   **PRODUCT DEVELOPMENT LABORATORY**   **L T P C**
                                                                     1 0 2 2

COURSE OUTCOMES

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

- CO1: recognize the needs of the customer and select concept to meet the requirements (K4)
- CO2: verify the functionality of the concept through prototyping (K4)

UNIT I   NEED IDENTIFICATION, TARGET SPECIFICATIONS AND CONCEPT SELECTION   20

Planning-customer need identification through empathy, problem definition, target specifications, concept development and selection.

UNIT II   PROTOTYPING AND DEMONSTRATION   25

Prototype development and demonstration - cost estimation - product documentation

L: 15; P: 30; TOTAL: 45 PERIODS

REFERENCES

1. Michael G Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", Willey, 2015
2. Christian Muller-Roterberg, "Design Thinking", Wiley Publications, 2021
3. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata Mc Graw Hill Education, 4th Edition, 2011.
4. George E Dieter, Linda C Schmidt, "Engineering Design", Mc-Graw Hill International Edition, 5th Edition, 2013.
5. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint, Pearson Education, 2013

Mentor Activities

- Forming multidisciplinary/interdisciplinary batches among the students
- Facilitating the batches to define a problem through empathizing
- Guiding the batches to develop a prototype to verify the functionality of the concept
- Evaluating the students' activities through demonstration and presentations

End semester Assessments can be made through

- Product demonstration and presentation

Other points

- This course is for all department students
- Course instructor and mentors will be responsible for the academic process.
- In a project batch, maximum number of students shall be limited to four
- Project batch may be interdisciplinary / multidisciplinary
- Multidisciplinary project batches are encouraged and permitted to take mentors from various discipline.

19CE59E	CONSTRUCTION MANAGEMENT AND SAFETY	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Understand the various stages involved in a construction project (K2)

CO2: Apply the professional skills acquired in managing a construction project. (K3)

CO3: Apply the idea on effective resource utilization and identify factors affecting job productivity. (K3)

CO4: Understand knowledge about safety programmes & job-site safety assessment. (K2)

CO5: Apply knowledge while designing for safety and safety procedures. (K3)

UNIT I   INTRODUCTION   9

Introduction - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers – Network Analysis – CPM and PERT

UNIT II   ORGANIZING FOR PROJECT MANAGEMENT   9

Project Management – Modern trends - Effects of Project Risks on Organization - Organization of Project Participants - Traditional Designer - Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team

UNIT III   LABOUR, MATERIAL AND EQUIPMENT UTILIZATION   9

Historical Perspective - Labor Productivity - Factors Affecting Job-Site Productivity - Labor Relations in Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks.

UNIT IV   SAFETY PROGRAMMES   9

Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings - Safety Culture – Safety Incentives - Safety Record Keeping - Workers Compensation.

UNIT V   DESIGNING FOR SAFETY   9

Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel Substance Abuse – Sub contractual Obligation – Project Coordination and Safety Procedures.

L: 45, TOTAL: 45 PERIODS

TEXTBOOKS

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 3rd Edition, 2014.
2. Bhattacharjee S.K. Safety Management in Construction (Principles and Practice), Khanna Publishers, New Delhi 2011.

REFERENCES

1. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 2017.
2. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2nd Edition, 2000.
3. Patrick X.W. Zou, Riza Yosia Sunindijo, Strategic Safety Management in Construction and Engineering, John Wiley & Sons, Ltd 2015.
4. Tamil Nadu Factory Act, Department of Inspectorate of factories, Tamil Nadu Health Management, Prentice Hall Inc., 2001.

19CE60E	SAFETY IN CIVIL ENGINEERING PRACTICES	L T P C
		3 0 0 3

COURSE OUTCOMES

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

CO1: Create a safety checklist for housekeeping and electrical hazards. (K2)
CO2: Recommend the safety guidelines when working under trenches and excavations (K2)
CO3: Develop a safety procedure for formwork systems and concrete operations. (K2)
CO4: Identify the hazards and safety guidelines associated with erection and dismantling of scaffolding and roof truss system. (K2)
CO5: Formulate the safety recommendations when handling hand and power tools in the construction project. (K2)

UNIT I   PRE- CONSTRUCTION CONSIDERATIONS   9

Planning and scheduling – Housekeeping and on-site safety – Basic checklist – Asbestos removal – Electrical power lines – Overhead high-voltage electricity – Overhead low-voltage electricity – Underground electrical hazards.

UNIT II   CONSTRUCTION   9

Basic personal protective equipment and clothing – Foot protection – Head protection – Hearing protection – Trenches and excavations – General requirements – Sloping and shoring requirements – Additional excavation requirements

UNIT III   FORMWORK AND POURING   9

Formwork – Concrete pouring and pumping - General framing - Guardrails and floor openings, Floor and roof openings – Lifting walls – Fall protection – Selecting fall protection – Planning for fall protection on your project – Fall protection plan.

UNIT IV   TRUSSES AND ROOF WORK   9

Trusses – Instruction for truss installers – Truss erection Roof work – Roof jacks and toe-holds(slide guards) Scaffolds – Guardrails for scaffolds – Toe boards for scaffolds – Wood scaffold erection guidelines – Design and erection requirements for job – constructed wood scaffolds Scaffold planks – Other types of scaffolds– Ladder-jack scaffolds – Trestle scaffolds – Shore and lean-to scaffolds – Rolling scaffolds

UNIT V   EQUIPMENT SAFETY   9

Ladders Requirements for safe ladder use – Job-built ladder– Stepladders – Safe Work Practices for House – Construction – Electrical power tools and cords – Safe work procedures – Hand tool ergonomics Factors affecting tool use – Reducing risk of injury – Compressed air for cleaning – Pneumatic nailing and stapling equipment – Safe work procedures – Power tools—saws – Basic safety Kickback – Construction site hazards.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

REFERENCES

1. Hand Book on Construction Safety Practices, SP:70, BIS, 2001.
2. S.K. Bhattacharjee, Safety Management in Construction (Principles and Practice) Khanna Publishers. First Edition , 2011.

19CE61E   REMOTE SENSING AND GIS FOR ENGINEERING APPLICATIONS
L T P C
3 0 0 3

COURSEOUTCOMES

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

CO1: characterize electromagnetic radiation and its interaction with earth features (K2)
CO2: classify platforms and sensors (K2)
CO3: conceptualize the processes in digital image formation and interpretation. (K2)
CO4: understand the cartographic principles of Map preparation. (K2)
CO5: understand GIS components, standards and data formats. (K2)

UNIT I   PRINCIPLES OF REMOTE SENSING   9

EMR-wave theory- particle theory-Radiation principles-plank, Stefan,Boltzman, Kirchoff, Wein's law- spectrum for remote sensing-EMR interaction with atmosphere –Rayleigh, mie, non-selective scattering, absorption, refraction-atmospheric windows-EMR interaction with earth's surface-reflection, transmission -spectral signature vegetation, water, soil- Factors affecting spectral reflectance of vegetation, soil and water body-Active & Passive remote sensing- Multispectral & hyperspectral remote sensing - Case study –wavelength identification for applications

UNIT II   PLATFORMS & SENSOR   9

Spaceborne platforms-Airborne platforms –UAV-Principle of photography- camera, sensor-types - Optics-Lenses, mirrors, prisms-Radiative transfer function -sensitivity, aperture, shutter speed-filters- Detectors-noise-types Sensitivity, time, and frequency response - hybrid photo detectors - Imaging detectors - CCD –CMOS-TIR- RADAR-SAR-LIDAR-High resolution sensors-S/N Ratio-Case study-sensor selection

UNIT III   DIGITAL IMAGE PROCESSING   9

Digital Image fundamentals -processing system- data products-formats-sensor model - spectral & spatial response-IFOV,GIFOV,GSI-sampling & quantization - Resolution, Image representation -geometry, radiometry and color concepts-image degradation-atmospheric, radiometric, geometric correction-image restoration-interpolation & resampling - filters-image segmentation-elements of interpretation-image histogram-scattergram - statistics-elements of interpretation – segmentation - classification: supervised, unsupervised-accuracy assessment-case study-steps involved in a satellite image processing

UNIT IV   DIGITAL CARTOGRAPHY   9

Definition of Cartography - Maps - functions - uses – Types of Maps – Map Scales and Contents – Map projections – shape, distance, area, and direction properties – perspective and mathematical projections – UTM and UPS references -Indian maps and projections – Map co-ordinate systems- element of map-Map Reproduction-Map Generalization-geometric & coordinate transformations-bilinear and affine transformation - case study-length and area calculation

UNIT V   GIS   9

Introduction-components: hardware, software, data, people, method-data quality-aspects and assessment-metadata-GIS standards-OGC-interoperability-assessment - types of data: raster data models -GRID-vector data models-topology-GPS data integration-rasterization-vectorization-TIN-attribute data-levels of measurement-spatial join –non spatial join-attribute data link-terrain representation-DEM, DSM, DTM-case study-2D, 3D map representation-choropleth-isopleth

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Richards, Remote sensing digital Image Analysis-An Introduction Springer - Verlag 1993.
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.
3. C.P. Lo Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall of India Publishers, 2006
4. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.

REFERENCES
1. Arthur, H. Robinson, Elements of Cartography, Seventh Edition, John Wiley, and Sons, 2004.
2. John Campbell, "introductory Cartography", WC. Brown Publishers, 3rd Edition, 2004

19CE62E   UAV PHOTOGRAMMETRY   L T P C
4 0 0 4

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

CO1: identify the components of UAV (K2)
CO2: understand the photogrammetric concepts involved in UAV (K2)
CO3: classify the payloads and its applications (K2)
CO4: conceptualize the data processing involved in Preparation of data products (K2)
CO5: identify some application of UAV through case studies (K2)

UNIT I   INTRODUCTION TO UAV   12
Introduction-components-History of UAV – Classification - Parts and functions of Fixed, Rotorcraft and flapping wing UAV-types of drones-Launching methods – navigation-guidance-types-telemetry-communication systems-ground control stations

UNIT II   PHOTOGRAMMETRIC CONCEPT   12
Photogrammetry-Definition-application- Types of photographs – Types of projections-- photogrammetric sensors -Vertical photographs: perspective geometry - scale –flying height-ground coordinates- relief displacement-Tilted photograph-scale-flying height-ground coordinates- relief displacement –tilt displacement-stereoscopic vision-conditions for good stereo vision-depth perception-stereoscope-parallax-geometry of vertical photo-sources of errors in parallax equation-base lining-Flight planning – computation

UNIT III   PAYLOADS FOR UAV   12
Payloads – Classification of Payloads – camera – sensors – radars – various measuring devices – classification of payload based on applications – Hyper spectral sensors – LiDAR – SAR – thermal cameras – ultra sonic detectors – case study

UNIT IV   DATA PROCESSING   12
Interior Orientation – Exterior Orientation – Aerial Triangulation – Block Adjustment – DEM – DSM – DTM –3D Model –slope- Contour and Ortho photo Generation

UNITV   APPLICATION AND CASE STUDIES   12
UAVs in Topographical Survey – Mine Surveying – Project Progress Monitoring – 3D Modelling of Monuments and Historical Sites – Agriculture

L: 60; TOTAL: 60 PERIODS

TEXT BOOKS
1. Rampal, K. K., 1982, Textbook of photogrammetry, Oxford & IBH: New Delhi.
2. Slama, C. C. (Editor-in-Chief), 1980, Manual of Photogrammetry, American Society of Photogrammetry, 4 th ed., Bethesda, MD.
3. Moffit, F. H., 1959, Photogrammetry, International Textbook company: Scranton.
4. Wolf, P. R. and Dewitt, 2000, Elements of Photogrammetry with applications in GIS, McGraw Hill: Boston.

REFERENCES
1. Tiwari, R. S. and Badjatia, R. C., 1985, Elements of Photogrammetry and Remote Sensing, QIP short term course, Department of Civil Engineering, University of Roorkee, June 23- July 6, 1995.
2. Sadasivam, S, 1988, Photogrammetry, Volume I, Lecture notes for Summer School

on Photogrammetry for Transportation Engineers, Department of Civil Engineering, College of Engineering, Anna University, Madras, May 4 - 17, 1988.

3. Atkinson, K. B., 1996, Close range photogrammetry and machine vision, Whittles publishing, Caithness, Scotland, U.K.
4. Mikhail, E. M. and Bethel, J. S., 2001, Introduction to modern photogrammetry, John Wiley & Sons, Inc.
5. Wolf, P.R. and Ghilani, C.D., 2002, Elementary surveying, an introduction to geomatics, X edition, Prentice Hall: New Jersey.
6. Heipke, C., Digital Photogrammetric Workstations - A review of the state-of-the-art for topographic applications (downloaded in 2003).
7. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
8. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
9. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
10. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998

19CE63E	TOTAL STATION AND GPS SURVEYING	L T P C
		4 0 0 4

COURSE OUTCOMES

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

CO1: understand the fundamentals of Total Station and GPS (K2)

CO2: characterize EDM and know the principles of EDM (K2)

CO3: know the components, types of Total station and methods of measurements (K2)

CO4: know the components, types of GPS and methods of measurements (K2)

CO5: determine the GPS observables, formats and data processing methods (K2)

UNIT I   FUNDAMENTALS OF TOTAL STATION AND GPS   12

Introduction to Total Station, Historical Development, Classifications, Engineering applications – Introduction to GNSS - Historical perspective and development – classifications-Engineering applications - advantages over conventional surveying instruments - Datum- Geoid and Ellipsoid- satellite orbital motion - Keplerian motion – Kepler's Law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept in IRNSS-GAGAN-GLONASS-GALILEO

UNIT II   ELECTROMAGNETIC DISTANCE MEASUREMENT   12

Classification of EMR – EMR Propagation through atmosphere - working principle of EDM- wave propagation through atmosphere- Refractive index (RI) - Computation of group RI for light & near infrared waves at standard and ambient conditions- Computation of RI for microwaves - factors affecting RI – errors – velocity correction - first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -– geometric correction- Total atmospheric correction

UNIT III   TOTAL STATION   12

EDM-principles- Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments -Total station- parts-features- Types- measurement modes-Field techniques: Point location, slope reduction, missing line measurement-resection-azimuth calculation, remote distance & elevation measurement-offset measurements-layout or setting out operation- area & volume measurement-tracking – stake out- field equipment's: reflector prism & targets-Care and maintenance of instruments- Modern positioning systems – Traversing and Trilateration – Methods of Measuring Distance, Area and volume -Flowchart of data collection- COGO functions, offsets and stake out-land survey applications- latest technologies- automatic target recognition

UNIT IV   SATELLITE SYSTEM   12

Different segments - space, control, and user segments – Anti Spoofing and Selective Availability – Measurement &Positioning with GPS- Task of control segment - GPS receivers - types-components- Study of Handheld GPS, Geodetic GPS, Static and semi kinematics survey

UNIT V   GPS DATA PROCESSING   12

GPS observables - Orbit determination and representation -GPS signal structure - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data -data processing – software modules -solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static methods with GPS - semi-Kinematic and pure Kinematic methods -basic constellation of satellite geometry & accuracy measures - applications- long baseline processing-use of different software's available in the market.

L: 60; TOTAL: 60 PERIODS

TEXT BOOKS

1. Duggal,Rueger, J.M. "Electronic Distance Measurement", Springer-Verlag, Berlin, 1990.
2. Satheesh Gopi, rasathishkumar, madhu N., "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007

REFERENCES

1. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 1993.
2. Guocheng Xu, "GPS Theory, Algorithms and Applications", Springer - Berlin, 2003.
3. Alfred Leick, "GPS satellite surveying", John Wiley & Sons Inc., 3rd Edition, 2004.
4. Seeber G, "Satellite Geodesy", Walter De Gruyter, Berlin, 1998

19CE64E   TERRESTRIAL, MOBILE, AND AERIAL LIDAR   L T P C
                                                                      3 0 0 3

COURSE OUTCOMES

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

   CO1: conceptualize LIDAR and classify LIDAR. (K2)

CO2: understand the working principles of TLS and BLS. (K2)
CO3: understand the working principles of MLS & ALS. (K2)
CO4: identify the processes involved in data acquisition and data processing. (K2)
CO5: identify some application of LIDAR through case studies. (K2)

UNIT I   INTRODUCTION TO LIDAR   9
Introduction - History – Principle & properties of LiDAR – Wavelength –components - Types–Ranging principle- pulse laser and continuous wave laser – First return & second return – Ellipsoidal & Geoidal height- Difference between LiDAR & Photogrammetry – altimetry – LiDAR Platforms: Terrestrial, airborne & spaceborne- LASER classification: class I-VI – eye safety

UNIT II   TERRESTRIAL LIDAR   9
Terrestrial Laser scanners (TLS) – introduction- working principle-static TLS- dynamic TLS-vehicle mounted TLS-Commercial TLS specifications-Components of Terrestrial LiDAR System – TLS Indoor Scanning Method – TLS Outdoor Scanning Method – Bathymetric Laser Scanners (BLS) -working principle of BLS-depth of penetration of BLS-Technical Specifications of market available various TLS and BLS- Applications of TLS & BLS

UNIT III   MOBILE LIDAR & AERIAL LIDAR   9
Components of Mobile LiDAR – Mobile LiDAR Scanning Method – Airborne Topographic Laser Scanner (ALS) -–parameters of ALS - Components of ALS - GPS, IMU, laser scanner, imaging device, hardware & software -Technical Specifications of market available various MLS and ALS – Data formats

UNIT IV   LIDAR DATA ACQUISITION & PROCESSING   9
Scanning Mechanisms - synchronization of GPS, IMU, laser scanner - data-reflectivity of terrain objects- Flight planning - determination of various data acquisition parameters – Pre-Processing - Area covered - swath width-point density- strips-point spacing - Data Transfer – determination of flight trajectory– Post Processing – geo location of laser foot prints – coordinate transformation – filtering – ground point filtering - Classification – Generation of General Outputs (Topographical Map, DEM, DSM, DTM, Contour)

UNIT V   APPLICATION AND CASE STUDIES   9
Post processing software's - TLS Applications – 3D Documentation of Monuments; MLS Applications – Land Plan Survey; ALS Applications – Irrigation Applications; Infrastructure Applications: Corridor mapping applications, 3D city model; Forestry Applications -Application of BLS

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. Jie Shan and Charles K. Toth, Topographic Laser Ranging and Scanning – Principles and Processing,Second Edition, CRC Press, Taylor, and Francis Group, 2018
2. Pinliang Dong, Qi Chen, LiDAR Remote Sensing and Applications, 1st Edition, CRC Press 2018

3. George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning, Whittles Publishing, 2010.
4. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013.

REFERENCES
1. Matti Maltamo, Erik Naesset, Jari Vauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht, 2016, Reprint Edition. ISBN 97894-017-8662-1
2. Zhilin Li, Qing Zhu, Chris Gold, Digital terrain modeling: principles and methodology, CRC Press, 2005
3. Roger Read and Ron Graham, Manual of Aerial Survey: Primary Data Acquisition, Whittles Publishing, 2002.

19CE65E	**UAV PHOTOGRAMMETRY LABORATORY**	**L T P C**
		0 1 3 2

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO1: understand the GIS environment and methods for preparation of map, layout & drawings. (K2)

CO2: summarize the UAV instruments and methods of survey. (K2)

CO3: construct 3D outputs and finished products. (K2)

LIST OF EXPERIMENTS
1. Spatial data: Raster & Vector Data Formats with File Extensions
2. Spatial Data Input:
   - Spatial data download: Raster & Vector data
   - Scanning
   - On-Screen Digitization, Creation of Point, Line, Polygon
   - Editing, Topology Creation, length, and Area Measurements,
3. Non spatial data Input: Data Attribution
4. Error Identification – Error estimation, Sources, Correction
5. Ground Control Network Establishment
6. Flight Planning
7. UAV Data Acquisition
8. Data Processing
9. Output Generation
   - Topographical Map
   - Orthophoto
   - DEM, DSM, DTM
   - Contour
   - 3D Model

T: 15; P: 30; TOTAL: 45 PERIODS

TEXTBOOKS
1. Zhilin Li, Qing Zhu, Chris Gold, Digital terrain modeling: principles and methodology, CRC Press, 2005
2. Roger Read and Ron Graham, Manual of Aerial Survey: Primary Data Acquisition, Whittles Publishing, 2002.
3. Felipe Gonzalez Toro, Antonios Tsourdos, UAV or Drones for Remote Sensing Applications, Sensors, MDPI
4. David R. Green, Billy J. Gregory, Alex R. Karachok Unmanned Aerial Remote Sensing: UAS for Environmental Applications, Taylor & Francis CRC press 2020

REFERENCES
1. Rampal, K. K., 1982, Textbook of photogrammetry, Oxford & IBH: New Delhi.
2. Slama, C. C. (Editor-in-Chief), 1980, Manual of Photogrammetry, American Society of Photogrammetry, 4th ed., Bethesda, MD.
3. Moffit, F. H., 1959, Photogrammetry, International Textbook company: Scranton.
4. Wolf, P. R. and Dewitt, 2000, Elements of Photogrammetry with applications in GIS, McGraw Hill: Boston.

19CE66E   TOTAL STATION AND GPS SURVEYING LABORATORY   L T P C
0 1 3 2

COURSEOUTCOMES
Upon Successful completion of this course, the students will be able to
CO1: work with Total Station and GPS instruments for measurement and mapping. (K2)
CO2: use Total Station and GPS for alignment and setting out works. (K2)
CO3: process the data from Total Station and GPS. (K2)
CO4: prepare outputs and finished products. (K2)

LIST OFEXPERIMENTS
1. Tripod setting – bubble setting – tilt setting
2. Create job/file, station, back sight, fore sight, pole handling
3. Measuring and storing points – Length, Area & Volume Measurement
4. Check measurement conventional method - Length, area & volume calculation
5. Change point shift by foresight method
6. Change point shift by resection,
7. Remote distance &Elevation Method & Missing Line Method
8. Layout & setting out: Using coordinates method, using distance and angle method, points at equal length & column marking
9. Distance, angle, and Coordinate Measurement
10. slope reduction,
11. azimuth calculation,
12. offset measurements-
13. Traversing

14. Trilateration
15. Level shifting
16. GPS connections and settings and Operation
17. Differential Positioning: Base, Rover
18. Precise Positioning, RTK, PPK and static methods
19. Setting out, COGO
20. GPS Traversing
21. Data download
22. Data Processing
23. Converting data into dwg, shape and other interoperable format
24. Preparation of maps in GIS

T: 15; P: 30; TOTAL: 45 PERIODS

TEXTBOOKS
1. Rueger, J.M. "Electronic Distance Measurement", Springer-Verlag, Berlin, 1990.
2. Satheesh Gopi, ra Sathish kumar, madhu N., "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007

REFERENCES
1. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 1993.
2. Guocheng Xu, "GPS Theory, Algorithms and Applications", Springer - Berlin, 2003.
3. Alfred Leick, "GPS satellite surveying", John Wiley & Sons Inc., 3rd Edition, 2004.
4. Seeber G, "Satellite Geodesy", Walter De Gruyter, Berlin, 1998.

19CE70E	INTELLIGENT TRANSPORTATION SYSTEMS	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO1: Understand the concepts of intelligent transportation system. (K2)
CO2: Apply the telecommunication facilities for intelligent transportation system. (K3)
CO3: Understand the functional areas of application using intelligent transportation system. (K2)
CO4: Apply the managing principles of intelligent transportation system. (K3)
CO5: Apply the concepts of implementing intelligent transportation system. (K3)

UNIT I   INTRODUCTION   9

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT II   TELECOMMNUNICATION   9

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

UNIT III   FUNCTIONAL AREAS   9
ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT IV   MANAGEMENT CONCEPTS   9
ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

UNIT V   IMPLEMENTATION   9
Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Pradip Kumar Sarkar, Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning, 2018.
2. Srinivasa R Kumar, "Intelligent Transportation Systems," Orient Blackswan Pvt Ltd, 2021.

REFERENCES
1. Samuel Morgan, "Intelligent Transportation Systems: Technologies and Applications", Clanrye International, 2015.
2. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

19CE71E   ROAD TRANSPORT MANAGEMENT AND ECONOMICS   L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
CO1: Understand the concepts of road transport management. (K2)
CO2: Apply the knowledge about transportation terminals and facilities. (K3)
CO3: Understand the cost involved in road transport management. (K2)
CO4: Apply the principles of economics in road transport management. (K3)
CO5: Understand the methods of financing a road transport project. (K2)

UNIT I   INTRODUCTION   9

Motor Vehicles Act - statutory provision for road transport and connected organisations. Route scheduling, Freight transport, Vehicle scheduling, Optimum fleet size, Headway control strategies, Crew scheduling.

UNIT II   TRANSPORTATION TERMINALS   9
Depots and Terminals - Principles and types of layout, Depot location, Twin depot concept, Crew facilities. Design of parking facilities – Bus terminal, bus stops and bus bays.

UNIT III   TRANSPORTATION COSTS   9
Transportation costs - Supply and demand - elasticity of demand; Supply of transport services - Economics of traffic congestion - Pricing policy. Vehicle operating costs - Fuel costs - Maintenance and spares - Depreciation - Crew costs - Value of travel time savings - Accident costs.

UNIT IV   TRANSPORTATION ECONOMICS   9
Economic analysis of projects - Methods of evaluation - Cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; Indirect costs and benefits of transport projects.

UNIT V   FINANCING   9
Financing of road projects - methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Build-Operate-Transfer Schemes – Risk Analysis - Case Studies.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Winfrey, Economic analysis for Highways, International Textbook Company, Pennsylvania, 1969.
2. CRRI, Road User Cost Study in India, New Delhi, 1982.

REFERENCE
1. IRC, Manual on Economic Evaluation of Highway Projects in India, SP30, 2007.

19CE75E   ENVIRONMENTAL BIOTECHNOLOGY   L T P C
3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
CO1: Understand the basics of the recombinant DNA technology and its environmental applications (K2)
CO2: Understand the mechanisms behind the biodegradation of environmental pollutants (K2)
CO3: summarize the detoxification mechanism by the microbes (K2)
CO4: Apply the remediation technologies to restore the environment (K3)
CO5: Apply the appropriate cleaner technologies for treating the pollutants (K3)

UNIT I   BASIC CONCEPTS AND RECOMBINANT DNA TECHNOLOGY   9

General principles - Environmental Pollution; Types of Pollution; Principles of Recombination and Plasmids DNA Transformation - Recombinant DNA Technology - Polymerase Chain Reactions - Isolating and Cloning Fragments - Concept of Gene Probes - Fundamentals of Cloning - Insertion and Expression of Foreign Genes - Recombinant DNA Techniques in Biotechnology - Applications in Environmental Engineering - Environmental Issues.

UNIT II   BIODEGRADATION OF POLLUTANTS   9

Xenobiotic compounds and recalcitrance – Biodegradation of Xenobiotics – adaptation of microorganisms for nutrients removal – microbial systems – degradation of toxic pollutants – hydrocarbons: non halogenated and halogenated – industrial application and concerns - Biological treatment of Waste water – Biotechnology for Solid waste management.

UNIT III   MECHANISM OF DETOXIFICATION   9

Environmental fate of organic pollutants – mechanisms of detoxification – oxidation, reduction, and dehydrogenation – Microbial system for Heavy metal accumulation - Biotransformation of metals – Biosorption - Microbial leaching of metals – role of extracellular polymers to detect pollutants.

UNIT IV   BIO-REMEDIATION   9

Biotechnological remedies for environmental pollution – soil, water and air remediation – reclamation concepts bioremediation – Ecological Restoration - Air Pollution and Deodorization process in Industry – Applications

UNIT V   CLEANER TECHNOLOGIES   9

Biotechnology in biodiversity conservation – microalgal biotechnology and applications in agriculture - biogas biofuel production using microorganisms - Biomining of Resources – Integrated Waste Management - Biosensors in Environmental Monitoring and Analysis – Biofertillizers - Biopesticides

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS
1. Bruce E. Rittmann and Perry L. Mc Carty., Environmental Biotechnology: Principles and Application, McGraw –Hill International Edition, 2001.
2. Purchit, S.S., Biotechnology – Fundamentals and Applications, Student Edition, India, 2004.

REFERENCES
1. Manahan, S.E., Environmental Science and Technology, Lewis Publ., New York, 1997.
2. Gabriel Briton, Wastewater Microbiololgy, Fourth Ed., Wiley and Blackwell, 2011.
3. Jogdand S. N., Environmental Biotechnology, 3rd Edition, Himalaya Publisher, 2006.
4. S.C Bhatia., Hand Book of Environmental Biotechnology, Vol. 1, 2 & 3, Atlantic Publishers and Distributers Ltd., 2008.

19ID01E	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: analyze various global trends and identify the scope of a new product (K4)

CO2: perform requirement analysis and convert the requirements into design specification (K4)

CO3: translate conceptual idea into detailed design (K6)

CO4: create prototype to demonstrate the product (K6)

CO5: perform sustenance engineering to improve the longevity of the product (K6)

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends - Technical Trends - Economic Trends - Environmental Trends - Political/Policy Trends- PESTLE Analysis. Introduction to Product Development Methodologies and Management: Overview of Products and Services - Types of Product Development- Overview of Product Development methodologies - Product Life Cycle and PLM - Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering: Types of Requirements - Requirement Engineering - Analysis - Traceability Matrix and Analysis - Requirement Management System Design and Modeling: Introduction to System Modeling - Introduction to System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening and Evaluation - Concept Design - S/W Architecture - Hardware Schematics and simulation Detailed Design: Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing-Hardware Schematic - Component design - Layout and Hardware Testing.

UNIT IV IMPLEMENTATION AND INTEGRATION 9

Prototyping: Types of Prototypes -Introduction to Rapid Prototyping and Rapid Manufacturing. System Integration - Testing - Certification and Documentation: Introduction to Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and S/W systems - Introduction to Product verification and validation processes - Product Testing standards, Certification and Documentation.

UNIT V SUSTENANCE ENGINEERING AND BUSINESS DYNAMICS 9

Sustenance - Maintenance and Repair – Enhancements Product End of Life (EoL): Obsolescence Management - Configuration Management - EoL Disposal.

The Industry - Engineering Services Industry overview - Product development in Industry versus Academia.

The IPD Essentials - Introduction to vertical specific product development processes -

Product development Trade-offs - Intellectual Property Rights and Confidentiality - Security and configuration management.

L:45; TOTAL:45 PERIODS

TEXT BOOKS
1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw-Hill Education, 4th Edition, 2009.
2. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill International Edition, 5th Edition, 2012.

REFERENCES
1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint, Pearson Education, 2007.
2. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 4th Edition, John Wiley & Sons, 2013.
3. Yousef Haik, Shahin T M M, "Engineering Design Process", Cengage Learning, 2nd Edition Reprint, 2010.
4. James R Evens, William M Lindsay "The Management and control of Quality" Pub: son south-western (www.swlearning.com), 6th edition.
5. Reddy G B, "Intellectual Property Rights and the Law", Gogia Law Agency, 7th Edition Reprint, 2009.
6. Subbaram N R, "Demystifying Intellectual Property Rights", Lexisexis Butter worths Wadhwa, 1st Edition, 2009.

19ID02E	DISASTER MANAGEMENT	L T P C
		3 0 0 3

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
    CO1: Classify the various types of disaster. (K2)
    CO2: Interpret various natural and manmade disasters. (K2)
    CO3: Choose a Hazard Assessment procedure. (K3)
    CO4: Construct the protection measures against Disaster. (K3)
    CO5: Apply Science and Technology in Disaster Management. (K3)

UNIT I   INTRODUCTION TO DISASTER   9
Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle.

UNIT II   SOURCES OF DISASTER   9
Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear ,chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution,

deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

UNIT III DISASTER MITIGATION AND HAZARDS ASSESSMENT 10

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication - area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents.

UNIT IV DISASTER MANAGEMENT 9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue ,relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND
CASE STUDIES 8

Applications of Science and Technology (RS, GIS, GPS) - Early Warning and Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS
1. S.K.Singh, S.C.Kundu, Shobha Singh A, "Disaster Management", William Publications, New Delhi, 1997.
2. Vinod K Sharma, "Disaster Management", IIPA, New Delhi, 1995

REFERENCES
1. Annual Report, 2009-10, Ministry of Home Affairs, GOI.
2. K.Palanivel, "Disaster Management", Allied Publishers, 2015.

19ID03E	ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE **OUTCOMES**

Upon completion of this course, the student will be able to

CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)
CO2: explain the operation of wind energy systems. (K2)
CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
CO5: explain the concepts of hydrogen and fuel cell technology. (K2)

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

UNIT II   WIND ENERGY   9

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT III   BIO-ENERGY   9

Biomass: sources, characterization, principles of energy transfer technologies. Biogas: Feedstock, types of Biogas plant - parameters affecting biogas production.

UNIT IV   OTHER POWER PLANTS   9

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD - Geo thermal - OTEC - Tidal Power Plants.

UNIT V   HYDROGEN AND FUEL CELLS   9

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS
1. SoterisKalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, 2014.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 3rd Edition, 2012.

REFERENCES
1. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, "Fuel Cells: Theory & Applications", Prentice Hall, 1997.
3. EI-Wakil M M, "Power Plant Technology", Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, "Biogas Technology" - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, "Solar Engineering of Thermal Processes", Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", Prentice Hall of India, 3rd Edition, 2015.

B.E. CIVIL ENGINEERING
ONE CREDIT COURSES

19CE01L   RECENT ADVANCEMENTS INSPECIALCONCRETE   L T P C
                                                          1 0 0 1

COURSE OUTCOME

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

CO1: Explain the suitability of special concrete making materials, properties of special Concrete with its applications. (K2)

COURSE CONTENTS

Ultra High Strength Concrete – No fines concrete – High density concrete - Testing Methods – Aerated Concrete – Applications of Nano-concrete – Hot weather concreting – Cold weather concreting – its applications - Bacterial Concrete.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS

1. Shetty M.S., "Concrete Technology", S.Chand& Company, New Delhi,2008
2. Santhakumar. A.R, "Conrete Technology", Oxford university press,2007
3. M.L. Gambhir, "Concrete Technology", Tata Mc-Graw Hill Company, Noida, 2011.

REFERENCES

1. Orchard D.F., "Concrete Technology", Vol I & II,1998
2. Neville A.M "Properties of Concrete", Pearson Education,2008
3. "Construction and Building Materials" Elsevier Publications.
4. "Cement and Concrete Research, Elsevier Publications.

19CE02L   DESIGN OF FOUNDATION ELEMENTS   L T P C
                                                        1 0 0 1

COURSE OUTCOMES

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

CO1: Design Shallow Foundation (K2)
CO2: Design Deep Foundation (K2)

COURSE CONTENTS

Design of Combined footings- Design of Raft Foundation – Design of Piles- Design of Pile caps -Design of Machine foundations. Design of well foundation.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.
2. Varghese P.C., "Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi, 2009
3. Gambhir. M.L., "Design of Reinforced Concrete Structures ", Prentice Hall of India Private Limited, New Delhi, Fourth Edition,2011.

REFERENCES

1. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw Hill, New York, 1996.

2. Nainan P. Kurian, "Design of Foundation Systems, Principles and Practices, Narosa Publishing House, 3rd Edition, 2006.
3. Poulos, H.G., Davis, E.H., "Pile foundation analysis and design", John Wiley and Sons, New York, 1980.

19CE03L	EARTH RETAINING STRUCTURES	L T P C
		1 0 0 1

COURSE OUTCOMES

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

CO1: Explain the concept of lateral earth pressure in soil (K2)

CO2: Design a suitable earth retaining structure (K2)

COURSE CONTENTS

Introduction – State of stress in retained soil mass – Earth pressure theories –Classical and graphical techniques– Earth pressure due to external loads, empirical methods - Wall movement –Retaining structures-Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls - Design of anchor systems- Introduction to reinforced earth.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS

1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, 3rd Edition, Survey University Press,2014.
2. Das, B.M., "Principles of Geotechnical Engineering", 8th Edition, The PWS series in Civil Engineering, 2015.

REFERENCES

1. Militisky, J. and Woods, R., "Earth and Earth retaining structures",Routledge,1992
2. Day, R.W., "Geotechnical and Foundation Engineering: Design and Construction", Mc-Graw Hill, 1999.

19CE04L	TRAFFIC ENGINEERING AND SAFETY	L T P C
		1 0 0 1

COURSE OUTCOME

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

CO1: Explain the concepts of traffic survey, reasons of accidents and their preventive measures (K2)

COURSE CONTENTS

Traffic volume count, Methods of traffic volume count - Manual, mechanical, videography, passenger car unit. Presentation of traffic volume count. Speed studies, spot speed studies and its presentation, Speed and delay studies, Origin and destination studies and its presentation, Parking studies - Types of parking - Off street parking, On street parking, Accident studies - Causes of accidents, accident records condition and collision diagram, preventive measures.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2014.
2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2000.

REFERENCES
1. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management
2. Guidelines of Ministry of Road Transport and Highways, Government of India.
3. Subhash C.Saxena, A Course in Traffic Planning and Design, Dhanpat Rai Publications, New Delhi, 1989.
4. Transportation Engineering – An Introduction, C.Jotin Khisty, B.KentLall, Prentice Hall of India Pvt. Ltd, 2006.

19CE05L	BRIDGECONSTRUCTIONTECHNIQUES	L T P C
		1 0 0 1

COURSE OUTCOME
Upon Successful completion of this course, the students will be able to
   CO1: Explain the concepts of bridge construction techniques (K2)

COURSE CONTENTS
Complete Scaffolding –span by span construction - Balanced Cantilever - Push (incremental) launching– box pushing – Prestressed Prefabrication techniques.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi, 2018.
2. Rajagopalan,N "Bridge Superstructure", Alpha Science International,2006

REFERENCES
1. Phatak D.R., "Bridge Engineering", SatyaPrakashan, New Delhi, 1990.
2. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi, 2017.

19CE06L	DECENTRALISED WASTE WATER TREATMENT SYSTEM (DEWATS)
	L T P C
	1 0 0 1

COURSE OUTCOMES
Upon successful completion of this course, the student will be able to
   CO1: Outline the basic concepts of waste water treatment (K2)
   CO2: Illustrate the components of onsite sanitation (K2)

COURSE CONTENTS

Biological Treatment – Aerobic & Anaerobic Process – Suspended and Attached growth - Centralized and Decentralized waste water treatment system – Domestic waste water quality and quantity - Control Parameters – Dewats Components – Grease trap and Grit chamber– Anaerobic baffle reactor – Anaerobic filter – Planted soil filter – Horizontal gravel filter – Vertical sand filter – Ponds – Anaerobic and Aerobic ponds – Hybrid and Combined systems.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2014.
2. Soli.J Arceivala, "Waste water Treatment for Pollution Control and Reuse", Mc-Graw Hill Education, 2006.

REFERENCES

1. Metcalf and Eddy "Wastewater Engineering – Treatment and Reuse", Tata McGraw Hill, New Delhi, 2003.
2. Ludwig Sasse "DEWATS Decentralised wastewater treatment system in developing countries", Borda, 1998.

19CE07L	BUILDING MARKING	L T P C
		1 0 0 1

COURSE OUTCOMES

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

    CO1: Marking the building structures (K2)
    CO2: Marking for plumbing and electrical lines (K2)

COURSE CONTENTS

Study of building plan - Centre line method – Marking of load bearing structures – Marking of framed structures-Marking for plumbing and electrical lines – Setting out of building – Contour preparation – 3D scanning of building.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. S.C.Rangawala, "Engineering materials", Charotar Publishing House, NewDelhi, 2017.
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, DhanpatRai and Sons, 1997.

REFERENCE

1. Edward Allen and Joseph Iano, "Fundamentals of Building Construction", John Wiley & sons, 2009

19CE08L   **INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM (GIS)**

L T P C
1 0 0 1

COURSE OUTCOME
CO1: Outline the basic concepts of GIS and apply GIS software in Civil Engineering field (K2)

COURSE CONTENTS
Introduction – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS). Data models – vector and raster data – data compression - data input by digitization and scanning - Modeling in GIS Highway alignment studies.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS
1. Lillesand, T.M., Kiefer, R.W. and J.W.Chipman, "Remote Sensing and Image Interpretation", 5th Edition, John Willey and Sons (Asia) Private Limited, New Delhi. PP: 763, 2004.
2. Anji Reddy, M., "Remote Sensing and Geographical Information System", 2nd Edition, BS Publications, Hyderabad, 2001.

REFERENCES
1. Lo. C.P. and A.K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Private Limited, New Delhi, Pp: 492, 2002.
2. Peter A.Burrough, Rachael A. Mc Donnell, "Principles of GIS", Oxford University Press, 2000.

19CE09L   **TIMBER STRUCTURES**   **L T P C**
1 0 0 1

COURSE OUTCOMES
Upon successful completion of this course, the student will be able to
CO1: Explain the basic concepts of Timber Design (K2)

COURSE CONTENTS
Design process and structural loads - Timber building terminology (e.g. building systems) - Properties of timber and engineered wood products-General timber design principles - Design of bending, tension and compression members - Design of members under combined loads - Case Study of Existing Timber Structures, Design of formwork.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS
1. Abi Aghayere, Jason Vigil, "Structural Wood Design - ASD/LRFD, 2nd Edition", Taylor & Franchis (publisher), 2016.
2. Donald E. Breyer and Kelly Cobeen, "Design of wood structures-asd/lrfd (p/l custom scoring survey)" McGraw-Hill, 2014.

REFERENCES
1. Donald Breyer, Kenneth Fridley, Pollock Jr., Kelly Cobeen,"Design of Wood Structures-ASD/LRFD", McGraw Hill Professional, 2014.
2. Ram S Gupta, "Principles of Structural Design: Wood, Steel, and Concrete, Second Edition" Taylor & Francis (publisher), 2014.

19CE10L	EARTHQUAKE RESISTANT DESIGN	L T P C
		1 0 0 1

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
- CO1: Analyze the earthquake forces and their application on different types of structures. (K2)
- CO2: Design masonry and RC structures to resist the earthquake forces as per the IS Code recommendations.(K2)

COURSE CONTENTS
Structural Systems - Types of Buildings - Causes of damage - Planning Considerations – effect of material of construction on performance of structures application of lateral load - analysis of building frames under lateral load. Earthquake resistant design Concepts – virtues of EQR design – capacity based design - design of shear wall and frame members as per IS13920:1993 –Ductile detailing of frame members and shearwalls.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. Pankaj Agarwal and Manish Shri Khande, Earthquake Resistant Design of Structures, Prentice - Hall of India, New Delhi, 2003.
2. S.K. Duggal, Earthquake resistant design of structures, Oxford University Press, 2007.

REFERENCE
1. Paulay.T and Priestley M.J.N., "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons, 1992.

19CE11L	SEISMIC EVALUVATION AND RETROFITTING OF STRUCTRES	L T P C
		1 0 0 1

COURSE OUTCOME
Upon successful completion of this course, the student will be able to
- CO1: explain the seismic evaluation methods and retrofitting of Seismic Damages (K2)

COURSE CONTENTS
Seismic Evaluation Methods -Push over Analysis- Seismic Retro fitting – Damage Assessment Methods.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS
1. Pankaj Agarwal and Manish Shri Khande, Earthquake Resistant Design of Structures, Prentice - Hall of India, New Delhi, 2003.
2. S.K. Duggal, Earthquake resistant design of structures, Oxford University Press, New Delhi - 1.

REFERENCE
1. Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.

19CE12L	TUNNELING TECHNIQUES	L T P C
		1 0 0 1

COURSE OUTCOMES
Upon successful completion of this course, the student will be able to
 CO1: discuss about provisions and application of tunneling techniques (K2)

COURSE CONTENTS
Site investigations, Geotechnical Considerations of tunneling -Design of Tunnels - Construction & Excavation methods, soft ground tunnels, Rock tunnels -Micro tunneling techniques, Tunnel grouting, Tunnel support design-Ventilation of tunnels, tunnel utilities, safety aspects

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS
1. J O Bickel & T R Kuesel "Tunnel Engineering Handbook", CBS, 2nd Edition, 2004.
2. R. Srinivasan "Harbourand Dock and Tunnel", Charotar Publishing House, 28th Edition, 2016.

19CE13L	SOIL CONTAMINATION AND REMEDIATION	L T P C
		1 0 0 1

COURSE OUTCOMES
Upon successful completion of this course, the student will be able to
 CO1: Explain the soil-chemical interaction mechanism (K2)
 CO2: Explain various methods in soil remediation (K2)

COURSE CONTENTS
Role of Geo-environmental Engineering–soil pollution -factors influencing soil-pollutant interaction – modification of index, chemical and engineering properties – physical and physio-chemical mechanisms - Transport of contaminant in subsurface – characterization of contaminated sites – In-situ contamination– soil remediation - methods of soil remediation-vitrification-chemical oxidation-thermal desorption-stabilization-soil washing-bioremediation.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS
1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 2012.
2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering, John Wiley and Sons, INC, USA, 2004.
3. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.

REFERENCES
1. Lagrega, M.D., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management,, McGraw Hill, Inc. Singapore, 1994.
2. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.

19CE14L	ENVIRONMENTAL NOISE POLLUTION	L T P C
		1 0 0 1

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
 CO1: Outline the basic concepts of noise pollution (K2)
 CO2: Perceive the components of noise pollution mitigations. (K2)

COURSE CONTENTS

Noise Pollution – Causes- Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – Effects of noise pollution – auditory effects, non-auditory effects- effects of noise on workers efficiency- General Control Measures- Designing out Noise – Industrial Noise Control- Acoustic quieting - mechanical isolation technique, acoustical absorption, constrained layer damping – OSHA Noise standards – public education – other non legislative measures.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2014.
2. S.K.Agarwal., Noise pollution APH Publishing corporation, 2005.

REFERENCES
1. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 2009.
2. OSHA Standards for noise pollution (OSHAwebsite)(https://www.osha.gov/SLTC/noisehearingconservation/index.html).

19CE15L	SAFETYINCONSTRUCTION	L T P C
		1 0 0 1

COURSE OUTCOME

Upon successful completion of this course, the student will be able to
 CO1: Explain the Causes of accidents and principles selecting, operations, inspection and testing of various construction machinery. (K2)

COURSE CONTENTS

Problems impeding safety in construction industry- causes and types of accidents, construction regulations - design aids for safe construction - Temporary Structures-Economic Impact of Accidents-Modes of Failure-Causes and Characteristics of Accidents-Codes and Standards-Hazard Assessment and Control.

L: 15, TOTAL: 15 PERIODS

REFERENCES

1. Krishnamurthy, N., Notes for various short courses on Safety in Construction Industry.
2. Allan St John Holt, Principles of Construction Safety, Blackwell Science Publication, 2006.

19CE16L   DESIGN OF INDUSTRIAL ROOFING SYSTEM   L T P C
1 0 0 1

COURSE OUTCOMES

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

    CO1: Analyze Industrial components (K2)
    CO2: Design Industrial components by appropriate identification of structural steel (K2).

COURSE CONTENTS

Introduction to Indian Standard Code Provision – Applications of Roof truss system for industries – Analysis of Fink type, Fan type and Fink fan type Trusses- Roof and side coverings – Design loads – design of purlins –Analysis and Design of Tubular Trusses – Introduction to Pre Engineered Buildings.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. Dayaratnam.P, "Design of Steel Structures", 2nd Edition, S.Chand & Company, 2003.
2. Ramachandra.S and Virendra Gehlot, "Design of Steel Structures – Vol. I & II". Standard Publication, New Delhi, 2007.

REFERENCE

1. Bhavikatti.S.S., "Design of steel Structures", I.K.International Private Limited, 2009.

19CE17L   ADVANCED ENGINEERING MATERIALS IN CONSTRUCTION   L T P C
1 0 0 1

COURSE OUTCOMES

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

CO1: To impart knowledge from various types of properties uses and application of advanced materials used in construction (K2)

COURSE CONTENTS

Overview of advanced Materials - Factors Affecting Choice of selection of Materials - Steel, Non-ferrous, special concrete, construction chemicals, Glass, Plastics, Composites-

Fundamentals of Non-Mechanical Properties (physical properties, durability)- Fundamentals of Mechanical Properties (strength, structural performance) - Relation between Materials and their Applications in Buildings / Case Studies.

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. Errol Van Amsterdam "Construction Materials for Civil Engineering", Juta & Co. Ltd, 2008.
2. X. Yong, "Advanced Materials Science and Civil Engineering", WIT Press, 2015.

REFERENCES

1. G. D. Taylor, "Materials in Construction: An Introduction", published by route ledge 2013.
2. Peter Domone, John Illston, "Construction Materials: Their Nature and Behaviour, 4th Edition", Taylor & Francis, 2000.

19CE18L	ENVIRONMENTAL CLEARANCE	L T P C
		1 0 0 1

COURSE OUTCOMES

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

CO1: Apply the procedures and formats for Environmental Clearance in the Construction Field. (K2)

CO2: Identify the procedures needed for Environmental impact Assessment and Environmental Clearance. (K2)

COURSE CONTENTS

Impact – Environmental Impact Assessment (EIA) & Environmental Clearances – EIA necessity and its limitations- Environmental Impact Statement (EIS) – EIA capability and limitations –Impact assessment due to construction project- Legal provisions for EC– Environmental Clearance for Construction Projects- case studies.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS

1. Garg S.K., "Sewage Disposal and Air pollution Engineering", Khanna publishers, New Delhi.
2. T.V.Ramachandra, Vijay Kulkarni, "Environmental Management", Teri Publications, The Energy and the Research Institute New Delhi, 2009
3. Bala Krishnamoorthy, "Environmental management Texts and Cases", PHI learning Private Ltd.,New Delhi,2012

REFERENCES

1. http://www.moef.nic.in/environmental_clearance general; Indian Government official website MOEF-Ministry of Environment and forest and climate change.
2. http://www.indiaenvironmentportal.org.in/ basic engineering principles involved in EC and EIA.

19CE19L	ENVIRONMENTAL LEGISLATIONS	L T P C
		1 0 0 1

COURSE OUTCOMES

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

CO1: Perceive the Environmental legislative laws and its governing authorities. (K2)
CO2: Know the role of legislations and law in the field of climate Change. (K2)

COURSE CONTENTS

Different Environmental laws in India- Environmental laws World perspective- Importance of MoEF- Statutory bodies of pollution prevention CPCB,SPCB - Environmental Protection act 1986- Umbrella Legislations-The Air act - The water act -Role of NGT(National Green Tribunal)- Kyoto protocol -COP22.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS

1. Daniel Bodansky, Jutta Brunne., "International Climate Change law", Oxford university Press, London.Edition (2017).
2. Sengar, Dharmendra S "Environmental Law", Prentice Hall India Learning Private Limited; 1st Edition, 2007.
3. Bala Krishnamoorthy, "Environmental management Texts and Cases", PHI learning Private Ltd, New Delhi, 2012.

REFERENCES

1. http://unfccc.int/meetings/marrakech_nov_2016/session/9676.php United Nations framework and Convention on climate change.
2. http://www.indiaenvironmentportal.org.in/ basic engineering principles involved in Climate change.

19CE20L	ENVIRONMENTAL ENGINEERING DRAWING	L T P C
		1 0 0 1

COURSE OUTCOMES

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

CO1: Design the components of water and waste water treatment plant. (K3)
CO2: Draw the components of water and waste water treatment plant. (K2)

Design and drawing of

1. Clariflocculator
2. Screening along with Rapid sandfilters
3. Tricklingfilter
4. Activated sludgeprocess
5. Septic tank with dispersion trench and soakpit

L: 15; TOTAL: 15 PERIODS

REFERENCES

1. Modi, P.N., "Environmental Engineering I & II", Standard Book House, Delhi, 2010.
2. Garg, S.K., "Environmental Engineering Vol I & II", Khanna Publishers, New Delhi, 2014.

3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.

19CE21L	ANALYTICAL INSTRUMENTATION	L T P C
		1 0 0 1

COURSE OUTCOME

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

CO 1: Acquire the knowledge about the different types of analytical techniques to analysis the industrial liquid, solid, gases and radio chemical. (K1)

COURSE CONTENTS

Liquid Analysis

Liquid Analysis: Electrical conductivity, pH electrode potentials, Electrochemical analyser

Soild Analysis

X-ray diffraction, spectroscopic techniques IR and Raman, Electron microscopy (SEM, TEM and AFM)

Dissolved Component And Gas Analysis

Dissolved oxygen analyser–sodium analyser–silica analyser–moisture measurement – Oxygen analyser–CO monitor –NOx analyser–H_2S analyser–dust and smoke measurement–thermal conductivity type –thermal analyser–industrial analysers.

L: 15, TOTAL: 15 PERIODS

REFERENCES

1. R S Khandpur, "Hand book of Analytical Instruments", Tata McGraw-Hill Publishing Company, 2015.
2. Francis Rousseau and Annick Rouesssac, "Chemical analysis Modern Instrumentation Methods and Techniques", John Wiley& Sons Limited, 2007.
3. Dwayne Heard, "Analytical Techniques for atmospheric measurement", Blackwell Publishing, 2007.

19CE22L	COATING TECHNOLOGY	L T P C
		1 0 0 1

COURSE OUTCOME

Upon Successful completion of this course, the students will able to

CO1: acquire the knowledge about the different types of coatings (K2)

COURSE CONTENTS
INTRODUCTION

Organic and metallic coatings- oil and alkyd paints – thermosetting alkyd – polyester and acrylic paint based on nitrogen resin- epoxy coating.

NOBLE AND NON-NOBLE COATING

Tin coating – lead coating –copper coating- Zinc coating –zinc-iron alloy coating – aluminum coating.

CONVERSION COATING AND VAPOUR PROCESS COATING

Phosphate coating – chromate coating-oxide coating - Vacuum Evaporation – Sputtering - Chemical Vapor Deposition- Thermal spray coating.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. Philip A.Schweitzer, P.E. "Paint & Coating – Application and Corrosion Resistance", Toylor and Francis, New York, CRC press, 2006.
2. Arthur A. Tracton, "Coating Technology Hand book", CRC Press, Taylor & Francis Group, 2006.

REFERENCES
1. Arthur A. Tracton, "Coatings Materials and Surface Coatings" 3rdEdition, CRC Press, Taylor & Francis Group, 2006.
2. Philip A. Schweitzer, P.E. "Corrosion resistant lining and coating", New York, 2001.

19CE23L   **ACOUSTICS**   **L T P C**
                                                  1 0 0 1

COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
  CO1: Acquire knowledge on the acoustic properties of buildings (K2)
  CO2: Apply prediction methods to assess the transmission of noise in buildings (K3)
  CO3: Make basic room acoustic measurements (K2)

COURSE CONTENTS

UNIT I   ACOUSTICS OF BUILDING   5
Introduction - Sound generation mechanisms - Sound Insulation - Air Borne sound insulation-Impact sound insulation - Airborne sound reduction index for a solid, Homogeneous, Impervious wall -Coincidence effect - Methods of improving airborne sound insulation of building elements - Vibration control - Ventilation and conditioning systems.

UNIT II   CRITERIA FOR NOISE CONTROL AND SOUND INSULATION   5
Introduction - Hearing damage - Noise rating and Noise criteria curves noise in the home - Sound insulation between dwellings.

UNIT III   MEASURING TECHNIQUES   5
Generalized chain of measurement - Sources of sound and vibrations - Microphones and accelerometers - Amplifiers, Filters, Analyzers and Recorders.

L: 15; TOTAL: 15 PERIODS

TEXT BOOKS
1. A Text Book of Building Construction and Construction Materials, G S Birdie, T D

Ahuja, Dhanpat Rai Publishing Co, New Delhi,2007.

2. Architectural Acoustics Principles and Practice Cavanaugh & Wilkes John Wiley and Sons, New York, 1999.

REFERENCES

1. M. L. Munjal, 2014, Noise and Vibration Control, World Scientific Press: Singapore.
2. E. G. Williams, 1999, Fourier Acoustics: Sound Radiation and Near Field Acoustic Holography, Academic Press: New York.

19CE24L	COMPUTER AIDED BUILDING LAYOUT DRAWING	L T P C
		0 0 2 1

COURSE OUTCOMES

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

CO1: Generalize basic concepts of various elements of Residential / Institutional / Workshop buildings.(K1)

CO2: Identify and practice simulation software to draw truss structures, plan, elevation and sectional view of a building.(K2)

LIST OF EXPERIMENTS

1. Buildings with load bearing walls (Flat and pitched roof) – Including details of doors andwindows
2. RCC framedstructures
3. Industrial buildings – North light roof structures –Trusses
4. Perspective view of one and two storeybuildings

P: 30 TOTAL: 30 PERIODS

TEXT BOOKS

1. Varma B.P, "Civil Engineering Drawing & House Planning", 11th Edition, Khanna Publishers, Delhi,2013.
2. Shah M.G, "Building Drawing", Tata McGraw Hill,2012.

REFERENCES

1. Kumaraswamy N, KameswaraRao A, "Building Planning & Drawing", Charotar Publishing, 2012.
2. Shah, Kale and Patki, "Building Drawing with integrated approach to Built Environment", Tata McGraw Hill, 2012.

LIST OF EQUIPMENTS (For a batch of 30 students)

Sl. No	Description of Equipment's	Quantity
1.	Computer system of Pentium IV or Equivalent	1 for each student
2.	Licensed version of any reputed Analysis, Design & Drafting software	1 copy for a set of 3 student

19CE25L   C PROGRAMMING APPLICATIONS FOR CIVIL ENGINEERING-I   L T P C
0 0 2 1

COURSE OUTCOMES

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

   CO1: Apply the basic concepts to solve simple problems. (K3)

   CO2: Apply the appropriate solution to solve problems using Array and String handling.
       (K3)

LIST OF EXERCISES

1. Expression Evaluation: A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).

2. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+………….+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

3. A hydraulic piston has two ends of the area A1 = 1m^2 and A2 = 0.2m^2. A Force (F1) of 100N is applied on the piston with a smaller area. Write a C program to find the force on the other end. Given,

$$F_2 = \frac{F_1 A_2}{A_1}$$

4. A cantilever beam is given as shown in the following figure.
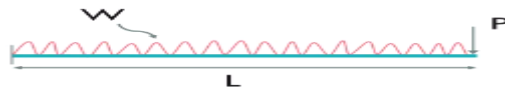
Write a C program to compute the shear and moment of beam at every L/N distance from a free end. Here, length of beam(L) is measured in metre, Concentrated Load (P) is measured in kN. Uniformly distributed load (W) is measured in kN/m. Let i indicate the sectional distance from the right side of the beam. Compute Shear and moment at each sectional point.

5. Write a C program to find the pressure difference that comes when someone goes 10m deep inside the water. Given, the density of water = 1000Kg/m^3.

6. Write a C program to find the maximum deflection in metre of a simply supported beam of span (AB) length L is measured in metre under mid-point load W in (kN).
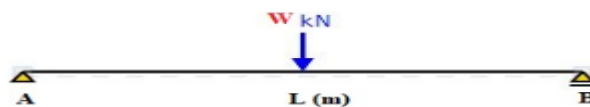
7. Write a C program to find the maximum deflection in metre of a simply supported beam of span (AB) length L is measured in metre under Uniformly distributed load W is measured in kN/m.

166
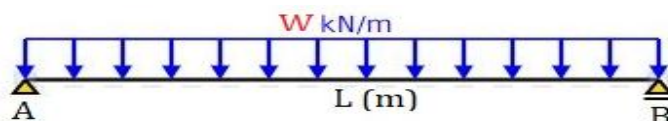
8. Write a C program to find the maximum deflection in meter of a cantilever beam of span (AB) length L is measured in metre under Uniformly distributed load W is measured in kN/m
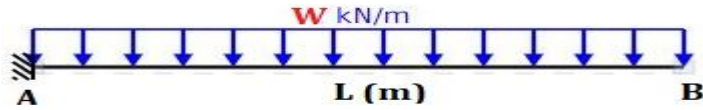
9. The flow rate of fluid required for the thermal energy - heat power transfer can be calculated

$$Q = \frac{3600.P}{\rho c \Delta T}$$

where: q - flow rate [m3/h]; ρ - density of fluid [kg/m3]; c - specific heat of fluid [kJ/kgK];
ΔT - temperature difference [K]; P - power [kW]; Write a C program to calculate the same by getting appropriate input values.

10. Two pipes are connected in parallel between two reservoirs that have difference in levels (HL) of 3.5 m. The length, the diameter, and friction factor (4 f) are 2400 m, 1.2 m, and 0.026 for the first pipe and 2400 m, 1 m, and 0.019 for the second pipe. Write a C program to calculate the total discharge between the two reservoirs $(Q_1 + Q_2)$.

$$H_L = \frac{32 f_1 L Q_1{}^2}{\pi^2 g d_1 5} = \frac{32 f_2 L Q_2{}^2}{\pi^2 g d_2 5}$$

11. Your task is to arrange the cement bags according to the weight (low to high or high to low). Take the input parameters in an array.
12. Write a program to initialize a one dimensional array of size N with the input elements as capacity of the sandbag and display the average of the total capacity.
13. Write a program in C to print individual characters of "Construction Materials" in reverse order.
14. Write a program in C to count total number of alphabets, special characters in a string " Reinforced Cement Concrete Structures"
15. Write a program to separate the individual characters from a string "CIVIL ENGINEERING"

Software Requirement: Turbo C   **P: 30; TOTAL: 30 PERIODS**

REFERENCES
1. Yashavant Kanetkar - Let Us C: Authentic guide to C programming language (18th Edition), 2021
2. Harsha Priya, R. Ranjeet, Programming and Problem Solving through C Language-ǁ, Fire wall Media, 2006.
3. M.G.Venkateshmurthy, Programming Techniques through C: A Beginner's Companionǁ, Pearson Education, (Kindle Edition), 2002.

19CE26L   C PROGRAMMING APPLICATIONS FOR CIVIL ENGINEERING-II   L T P C

0 0 2 1

COURSE OUTCOMES

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

CO1 : Analyze the problems using functions(K3)

CO2 : Solve problems using pointers(K3)

LIST OF EXERCISES

1. Using Functions, print all strong numbers between given intervals m,n (Hint: A number is strong whose sum of the factorial of the individual digits is equal to the number)

2. Using functions, read an integer and to check whether the

   i) number is prime

   ii) number is Armstrong

   iii) number is perfect number

3. Using recursive function, check whether the given string is a palindrome or not

4. Using pointers add two numbers and print the output

5. Using pointers swap elements using call by reference.

6. Using pointers store n elements in an array and print the elements using pointer.

7. Using pointers print a string in reverse using a pointer.

8. Using pointers, calculate sum of non-diagonal elements of m x n matrix using dynamic memory allocation.

9. Using Functions and pointers, calculate sum of major and minor diagonal elements of m xn matrix using dynamic memory allocation

Domain related questions:

1. Write a C program to find the total head of a flow (H) through a pipe. Get input variables as pressure (p), Specific Weight (ρg), velocity (v) and datum head (z). Using functions compute total head using the formula, H=(p/a) +((v*v)/(2*g))+z

2. Water flows in a steel pipe (d = 40 mm, k = 0.045x10-3 m, μ = 0.001 k/ms) with a rate of 1lit/sec. Using functions determine the friction coefficient and the head loss due to friction per meter length of the pipe.

3. Write a C program to read temperature in centigrade and display a suitable message according to temperature state below :

   Temp < 0 then Freezing weather

   Temp 0-10 then Very Cold weather

   Temp 10-20 then Cold weather

   Temp 20-30 then Normal in Temp

   Temp 30-40 then Its Hot

   Temp >=40 then Its Very Hot

Software Requirement: Code Blocks   **P: 30; TOTAL: 30 PERIODS**

REFERENCES

1. Brain W Kernighan, Dennis Ritchie, "C Programming Language", Pearson Edition, 2015

2. Yashavant P. Kanetkar, "Understanding Pointers in C", PBP Publications, 2007

19CE27L   C PROGRAMMING APPLICATIONS FOR CIVIL ENGINEERING-III   L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to
   CO1: Solve problems using Structure and unions (K3)
   CO2: implement linear data structures to solve simple problems (K3)

LIST OF EXERCISES

1. Write a C program to create student structure with members name,rno,dept,dob and arrange student data alphabetically.
2. Write a C program to create an employee structure with members empid, empname, salary. Access the members
      i.   Using structure variable
      ii. Using structure pointer
3. Write a C program to create a book structure with members bookname, authorname and accessno. Write a menu driven program for the following library operations
      i.   add the book details
      ii. display the book details
      iii. display the total number of books
4. Create two lists L1 and L2. While creating, the new nodes should be added in the front of the list by default.
      i.   Find the intersection of the two lists L1 and L2 and display the resultant list.
      ii. Find the union of two lists L1 and L2 eliminates the duplicates and display the resultant list.
5. Create a list. While creating, the new nodes should be added in the front of the list by default.
      i.   Delete the specified node
      ii. Find the specified node and return its position
      iii. Display the list and the number of nodes after each operation
      iv. Sort the given list
6. Create a stack ADT and perform the basic operations like pushing the element, popping the element and display.
7. Create a queue with 3 elements. Insert two elements at the front end and delete the last element at the rear end. Display the queue after each operation and number of elements in the queue.

Software Requirement: Code Blocks   **P: 30; TOTAL: 30 PERIODS**

REFERENCES

1. M.A. Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, 2002.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2008.

B.E. – CIVIL ENGINEERING
OPEN ELECTIVE COURSES

19ID01E	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: analyze the customer needs and convert them into product design specifications (K4)

CO2: perform concept generation and selection tools to identify the final concept (K4)

CO3: construct the detail design from the conceptual idea (K4)

CO4: understand rapid prototyping techniques in product development (K2)

CO5: recognize the Intellectual Property Protection methods and project management techniques (K2)

UNIT I   FUNDAMENTALS OF PRODUCT DEVELOPMENT   9

Introduction - A Generic Development Process - Field and Market analysis - Data collection techniques - Analysis of Data, PESTEL analysis - Identifying Customer Needs - House of Quality for Specifications - Establishing Target Specifications - Setting the Final Specifications.

UNIT II   CONCEPT GENERATION AND SELECTION   9

Concept generation activities - Pugh concept selection method: Concept screening; Concept scoring - Concept testing - Concepts for smart systems - Value Analysis.

UNIT III   EMBODIMENT DESIGN   9

System level Design and issues - Architecture of Product - Sizing of Parts - PESTEL analysis; SWOT analysis - Theory of inventive problem solving (TRIZ) - FAST Method - Failure Mode and Effects Analysis (FMEA) - Design for Assembly - Design for Ergonomics - Virtual Manikins

UNIT IV   RAPID PROTOTYPING   9

Prototyping techniques - Additive Manufacturing - Metal Additive Manufacturing techniques - Virtual Prototyping - Topology Optimization - Generative Design.

UNIT V   PROJECT MANAGEMENT AND INTELLECTUAL PROPERTY   9

Product Development Economics: Economic Analysis Process - Managing Projects: Protecting intellectual property - Patents, Trade mark and copy right.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill, International Edition, 5th Edition, 2012.
2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw-Hill Education, 4th Edition, 2009.

REFERENCES

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint, Pearson Education, 2007.
2. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 4th

Edition, John Wiley & Sons, 2013.

3. Yousef Haik, Shahin T M M, "Engineering Design Process", Cengage Learning, 2nd Edition Reprint, 2010.
4. James R Evens, William M Lindsay "The Management and control of Quality" Pub: son south-western (www.swlearning.com), 6th edition.
5. Reddy G B, "Intellectual Property Rights and the Law", Gogia Law Agency, 7th Edition Reprint, 2009.
6. Subbaram N R, "Demystifying Intellectual Property Rights", Lexisexis Butterworths Wadhwa, 1st Edition, 2009.

19ID02E	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE **OUTCOMES**

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

CO1: Classify the various types of disaster. (K2)
CO2: Interpret various natural and manmade disasters. (K2)
CO3: Choose a Hazard Assessment procedure. (K3)
CO4: Construct the protection measures against Disaster. (K3)
CO5: Apply Science and Technology in Disaster Management. (K3)

UNIT I   INTRODUCTION TO DISASTER   9

Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle.

UNIT II   SOURCES OF DISASTER   9

Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear, chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

UNIT III   DISASTER MITIGATION AND HAZARDS ASSESSMENT   10

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication – area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents.

UNIT IV   DISASTER MANAGEMENT   9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue, relief And Rehabilitation, Role of National and International Agencies in Disaster Management - National Disaster Policy of

India (Salient Features).

UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND 8
CASE STUDIES

Applications of Science and Technology (RS, GIS, GPS) - Early Warning and Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies.

L:45; TOTAL:45 PERIODS

TEXT BOOKS
1. S.K.Singh, S.C.Kundu, Shobha Singh A, - Disaster Managementǁ, William Publications, New Delhi, 1997.
2. Vinod K Sharma, Disaster Managementǁ, IIPA, New Delhi, 1995.

REFERENCES
1. Annual Report, 2009-10, Ministry of Home Affairs, GOI.
2. K.Palanivel, Disaster Management, Allied Publishers, 2015.

19ID03E	ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to
CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)
CO2: explain the operation of wind energy systems. (K2)
CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
CO5: explain the concepts of hydrogen and fuel cell technology. (K2)

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

UNIT II WIND ENERGY 9

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT III BIO-ENERGY 9

Biomass: sources, characterization, principles of energy transfer technologies. Biogas: Feedstock, types of Biogas plant - parameters affecting biogas production.

UNIT IV OTHER POWER PLANTS 9

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD - Geo thermal - OTEC - Tidal Power Plants.

UNIT V   HYDROGEN AND FUEL CELLS   9

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS
1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, 2014.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 3rd Edition, 2012.

REFERENCES
1. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, "Fuel Cells: Theory & Applications", Prentice Hall, 1997.
3. EI-Wakil M M, "Power Plant Technology", Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, "Biogas Technology" - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, "Solar Engineering of Thermal Processes", Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", Prentice Hall of India, 3rd Edition, 2015.

19TD01E	SOFT SKILLS AND INTERPERSONAL	L	T	P	C
	COMMUNICATION	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to:

CO 1: To Enhance the Soft skills for the usage of language effectively. (K3)

CO 2: To inculcate the various components of language skills. (K3)

CO 3: To Uplift the student's presentation skills and interpersonal skills. (K3)

CO 4: To enhance employability skills in students. (K3)

CO 5: To train the students in interview skills and preparing for job interviews. (K3)

UNIT 1

Introduction to Soft Skills- Aspects of Soft Skills- Types of Listening - Language Skills – Understanding and Overcoming barriers in communication- Ethics and Etiquettes (Social and Official Settings)- Negotiation.

UNIT II

Principles of communication - LSRW in communication - Oral – Speaking words – Articulation -written communication- Advanced Writing Skills- Evaluation and Organization of Data in Report Writing.

UNIT III

Advanced Speaking Skills- Verbal & Non verbal communication – Body language - Leadership and Assertiveness Skills-Networking- Decision-Making- Conflict-Resolution

UNIT IV

Methods of Presentation- Effective Reading - Group Discussion - Preparation for a group discussion- Emotional Intelligence- Critical Thinking.

UNIT V

Practicing for the Interview – Effective Resume building-Stress Interview and traditional Interview- Life and Career Planning- Facing Job Interviews.

TEXTS BOOKS

1. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
2. Kumar, Sanajy and Pushp Lata. Communication Skills. New Delhi: OUP. 2011.
3. Chauhan, G.S. and Sangeeta Sharma. Soft Skills. New Delhi: Wiley. 2016.
4. Lucas, Stephen E. The Art of Public Speaking. McGraw-Hill Book Co. International Edition, 11th Ed. 2014.

19TD02E   **IMPACT OF SOCIAL MEDIA ON SOCIETY**   L   T   P   C

0   0   0   3

COURSE   **OUTCOMES**

Upon completion of this course, the student will be able to

    CO1: discuss the basic operation of social media and its network.

    CO2: analyze the various theory corresponding to communication contexts.

    CO3: illustrate the impact of social media in physical and mental health of human beings.

    CO4: discuss the legal and ethical issues in public and private spheres

    CO5: illustrate the dark side of social media over growth of the society.

UNIT I   INTRODUCTION TO SOCIAL MEDIA

Evolution of Social Media, utility of social networks, Professional Networking for Career growth, photo sharing service, impact of video sharing on business, online communities

UNIT II   COMMUNICATION CONTEXTS FOR SOCIAL MEDIA

Mass Media theory, Social Sphere, Social Bookmarking and Social News, Social Opinion, Wikis, Crowdsourcing, Social Mobility, Privacy and Data Security.

UNIT III   SOCIAL MEDIA AND HEALTH

Stress and Anxiety, Depression, Suicide rates, Sleeping Patterns, Fitness, health and Eating habits, Addiction to social media. Psychological and Physiological impacts of Social media

UNIT IV   LEGAL AND ETHICAL ISSUES

Legal Pitfalls of Social Media usage, Redefining the Public and Private Spheres in Social Media, Tweets, Blogs, Facebook and Ethics of 21st Century Communication Technology.

UNIT V   DARK SIDE OF SOCIAL MEDIA USE FOR SOCIETIES

Privacy, Privacy Paradox and Social Media, Privacy Literacy, Use and gratifications Theory, Lying as a form of Deception, Online Deception, Deception using SOCIAL Media, Catfishing, Self-Presentation lies, Misinformation and Rumors.

TEXT BOOKS

1. Regina Luttrell and Adrienne A. Wallace "Social Media and Society – An Introduction to the Mass Media Landscape" by Rowman and Littlefield, 2021.
2. Pavica Sheldon, Philipp A. Rauschnabel, James M.Honeycutt "The Dark side of Social Media", Academic Press.

REFERENCES

1. Hana S.Noor AL-Deen and John Allen Hendricks " SOCIAL Media – Usage and Impact" Lexington Books,2018

19TD03E   **INTERNATIONAL BUSINESS MANAGEMENT**   **L T P C**
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COURSE OUTCOMES

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

    CO 1: understand the global business environment.

    CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.

    CO 3: discuss the issues and problems of Multinational Enterprises.

    CO 4: discuss the role of various international financial institutions.

    CO 5: discuss about important aspects of WTO and GATT agreement.

UNIT I   INTERNATIONAL BUSINESS ENVIRONMENT

International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

UNIT II   RISK ANALYSIS AND PRACTICES

Country Risk Analysis - Political, Social and Economic - Cultural and Ethical practices - Responsibilities of International Business - Economic crisis in foreign countries.

UNIT III   MULTINATIONAL ENTERPRISES

Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

UNIT IV   INTERNATIONAL FINANCIAL MANAGEMENT

Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

UNIT V   INTERNATAIONAL AGREEMENT

General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

TEXT BOOKS

1. Bhalla V.K, Shivaramu S, "International Business Environment", 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2. Apte P.G, "International Financial Management", 5th Edition, Tata McGraw Hill, India, 2008.
3. Cherulinam F, "International Business", 5th Edition, Prentice Hall of India, New Delhi, 2010.

REFERENCES

1. Rao, Rangachari, "International Business", Himalaya Publishing House, New Delhi, 2010.
2. Hill C, "International Business", 10th Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, "International Business Environment", 15th Edition, Prentice Hall of India, New Delhi, 2014.

19TD04E	BASICS OF MARKETING	L T P C
		0 0 0 3

COURSE OUTCOMES

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

CO 1: describe the basic concepts of marketing.

CO 2: discuss the significance of consumer behavior and market segmentation.

CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.

CO 4: formulate strategies for pricing and channels of distribution.

CO 5: analyze and selection of best promotional technique.

UNIT I   INTRODUCTION

Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

UNIT II   CONSUMER BEHAVIOR AND MARKET SEGMENTATION

Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

UNIT III   PRODUCT PLANNING

Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions - Brand Name and Trade Mark - After-Sales Service - Product Life Cycle Concept.

UNIT IV   PRICING AND PHYSICAL DISTRIBUTION

Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

UNIT V   PROMOTION

Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

TEXT BOOKS
1. Etzel M.J, Walker B.J, Stanton W.J, "Fundamentals of Marketing", 13th Edition, McGraw Hill, New York, 2004.
2. Tanner J, Raymond M, "Principles of Marketing", University of Minnesota Libraries Publishing, New York, 2015.

REFERENCES
1. Rajan Nair N, Varma M.M, "Marketing Management", 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2. Ramaswamy V.S, Namakumari S, "Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

19TD05E   **INDIAN ECONOMY**   **L T P C**
                                                              0 0 0 3
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: discuss the current economic development in India
CO 2: describe the key indicators of estimation of national income
CO 3: explain elementary concepts of economic planning and development in India
CO 4: discuss the concept of public finance and preparation of budget
CO 5: discuss the influence of infrastructure growth on economic development

UNIT I   ECONOMIC DEVELOPMENT
Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

UNIT II   NATIONAL INCOME
The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

UNIT III   ECONOMIC PLANNING
Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

UNIT IV   INDIAN PUBLIC FINANCE
Budgetary policies of the central government - Composition and trends in public revenue and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

UNIT V   INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Power and energy - Transport system in India's economic development - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

TEXT BOOKS

1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

REFERENCES

1. Arvind P, "India:The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

19TD06E   **INTERNATIONAL TRADE**   **L T P C**
                                                                0 0 0 3

COURSE OUTCOMES

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

CO 1: discuss the importance of international trade in developing countries.

CO 2: describe the impact of Trade agreements in international Business environment.

CO 3: explain the role of foreign exchange and their impact on trade and investment flows.

CO 4: discuss the benefits of Multinational Corporation in Internal Trade

CO 5: analyze the key role of globalisation in Indian economy.

UNIT I   **INTRODUCTION**

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

UNIT II   **INTERNATIONAL BUSINESS ENVIRONMENT**

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

UNIT III   **INTERNATIONAL FINANCIAL ENVIRONMENT**

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

UNIT IV   **MULTINATIONAL CORPORATIONS**

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances.

UNIT V   INDIA IN THE GLOBAL SETTING

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

TEXT BOOKS
1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

REFERENCES
1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

19TD07E   **GLOBAL CHALLENGES AND ISSUES**   **L T P C**
      0 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: understand the various global issues.
CO 2: demonstrate a reasonable understanding of environmental debates and issues.
CO 3: explain the developmental issues relating to food, health and energy.
CO 4: demonstrate the economical issues in international trade.
CO 5: describe the civilization issues relating to human rights and social justice.

UNIT I   SECURITY ISSUES
Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends - Cyber Terrorism – Counter Terrorism.

UNIT II   ENVIRONMENTAL ISSUES
Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green Cover and Wild Life.

UNIT III   DEVELOPMENTAL ISSUES
Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs. Environment - Sustainable Development.

UNIT IV   ECONOMIC ISSUES ON INTERNATIONAL TRADE
International Trade - GATT, WTO - Regional Associations - ECM, ASEAN, OPEC,

BRICS - Financial Crisis - ASEAN, Mexico and Greece - Global Issues in Trade and Commerce.

UNIT V   CIVILIZATION ISSUES

Human Rights - Issues Relating to Freedom of Speech and Expression - Right to Self Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and Children - Dividends of Globalization and Social Justice – Good Governance.

TEXT BOOKS

1. Payne R, "Global Issues", 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, "The Globalization of World Politics", 3rd Edition, Oxford University Press, USA, 2013.

REFERENCE

1. Chirco J.A, "Globalization: Prospects and Problems", Sage Publications, New Delhi, 2013.

19TD08E	INDIAN CULTURE AND HERITAGE	L T P C
		0 0 0 3

COURSE OUTCOMES

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

CO1: describe Indian culture, civilization and its features.
CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.
CO3: explain historical development of Indian culture.
CO4: explain the significance, conditions and development of Vedic culture.
CO5: analyze the advent of Islam and European culture.

UNIT I   INTRODUCTION

Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

UNIT II   PRE-HISTORIC CULTURE

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

UNIT III   HISTORICAL DEVELOPMENT OF INDIAN CULTURE

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture - IMPORTANCE of Indus Valley and Vedic Cultures.

UNIT IV   CULTURE IN SANGAM AGE AND POST SANGAM AGE

Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

UNIT V   ADVENT OF ISLAM AND EUROPEAN CULTURE

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

TEXT BOOKS

1. Luniya B.N, "Evolution of Indian Culture", Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, "History of Indian culture", Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, "Indian Culture and Heritage", Neha Publishers & Distributors, New Delhi, 2012.

REFERENCES

1. John G.A, "Dictionary of Indian Philosophy (Sanskrit-English)", University of Madras, Madras, 1998.
2. Misra R.S, "Studies in philosophy and Religion", Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, "Culture and Rationality", Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, "Religious in India", Sterling Publishers Pvt. Ltd., New Delhi, 1978.

19TD09E   INDIAN HISTORY   L T P C
                                                       0 0 0 3

COURSE OUTCOMES

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

    CO1: illustrate the basics of Indian cultural heritage.

    CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.

    CO3: demonstrate Innovation by rulers of medieval period in the area of Administration, and their contact with the Europeans.

    CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.

    CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

UNIT I   ANCIENTY INDIAN CULTURE

Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

UNIT II   LAW RELATING TO CULTURE

Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

UNIT III   ADMINISTRATION IN ANCIENT INDIA

Innovation by Rulers of Medieval Period in the Area of General and Revenue

Administration - District Administration - Court Systems - Indian Contact with the Europeans.

UNIT IV SOCIO-ECONOMIC HISTORY

Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

UNIT V EUROPEAN CULTURE IMPACT

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

TEXT BOOKS

1. Sreenivasa M.H.V, "History of India Part I and II", JBA Publishers, New Delhi, 2015.
2. Agarwal R.C, Bhatnagar M, "Constitutional Development and National Movement of India", S. Chand Publishers, New Delhi, 2005.

REFERENCES

1. Altekar S, "State and Government in Ancient India", Motilal Banarsidass Publishers, New Delhi, 2002.
2. Majumdur R.C, "History and Culture of the Indian People", Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

19TD10E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: recognize the sustainable development and the way to achieve the sustainable development.

CO 2: outline the concept, factors governing the sustainability and their linkages.

CO 3: explain the environmental impact assessment and environmental audit.

CO 4: describe the environmental planning and managing the resources.

CO 5: acquire the knowledge about the environmental problems and their solutions.

UNIT I SUSTAINABLE DEVELOPMENT

Need for Sustainability - 17 Sustainable Development Goals - Nine Ways to Achieve Sustainability - Economics as the Dismal Science - Population, Resources and Environment.

UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT

Concept of Sustainability - Factors Governing Sustainable Development - Linkages among Sustainable Development, Determinants of Sustainable Development - Case Studies on Sustainable Development.

UNIT III ENVIRONMENT IMPACT ASSESSMENT AND AUDIT

Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit programme - typical audit process - carrying out the audit-benefits of environmental auditing-environmental audit programmes in India.

UNIT IV   ENVIRONMENTAL PLANNING

Introduction - Perspective of Environmental Planning - land resource development planning - Planning and managing the natural resources - landscape ecological planning - information and decision of environmental planning - Land use policy in India.

UNIT V   ENVIRONMENTAL EDUCATION

Knowledge about the environment - Knowledge about the environment and population growth -Knowledge about the solution and environmental problems - Environmental education (EE) – Strategies for EE – Models for future Environmental Education Systems.

TEXT BOOKS

1. Rogers P, Jalal K.F, Boyd J.A, "An Introduction to Sustainable Development", Earth scan Publications Ltd., UK, 2006.
2. Santra S.C," Environmental Science", 3rd Edition, New Central Book Agency (P) Ltd., London, 2013.

REFERENCES

1. Stavins R.N. "Economics of the Environment: Selected Readings", 5th Edition, W.W. Norton and Company, New York, 2005.
2. Sachs J.D, "The Age of Sustainable Development", Columbia University Press, New York, 2015.

19TD11E	WOMEN IN INDIAN SOCIETY	L T P C
		0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to
    CO1: Demonstrate historical perspective about women in Indian society.
    CO2: Explain social problems of women.
    CO3: Understand the legislation for women protection in India.
    CO4: Demonstrate the involvement of women literacy, career and politics.
    CO5: Analyse the role of NGO's in women empowerment.

UNIT I   INTRODUCTION

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

UNIT II   SOCIAL ISSUES

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry

and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

UNIT III   PROTECTIVE LEGISLATION FOR WOMEN
Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence (Prevention) Act.

UNIT IV   WOMEN AND EDUCATION
Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

UNIT V   ROLE OF NGO'S IN WOMEN EMPOWERMENT
Gender Economy - Role of women in technology and education - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

TEXT BOOKS
1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.
2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

REFERENCES
1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.
2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

19TD12E	BIO MECHANICS IN SPORTS	L T P C
		0 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1**:** discuss the basics of biomechanics in sports & movement technique accurately.
   CO2**:** discuss the basics of linear kinematics and its applications in the field of sports.
   CO3: demonstrate the linear kinematics in the field of sports.
   CO4**:** discuss the basics of angular kinematics and its applications in the field of sports.
   CO5: demonstrate the angular kinematics in the field of sports.

UNIT I   INTRODUCTION
Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

UNIT II   LINEAR KINEMATICS

Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

UNIT III   ANGULAR KINEMATICS

Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

UNIT IV   LINEAR KINETICS

Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

UNIT V   ANGULAR KINETICS

Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

TEXT BOOKS

1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

REFERENCES

1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.