VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai)

(Accredited by NAAC with 'A+' grade)

Erode- 638012

B.E CIVIL ENGINEERING

CURRICULUM & SYLLABI

REGULATIONS - R2018 ver-4

(Incorporating Relative grading system)

CHOICE BASED CREDIT SYSTEM (CBCS)

I SEMESTER TO VIII SEMESTER

	VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)	CURRICULUM UG R – 2018 Ver 4

Department	Civil Engineering
Programme	B.E - Civil Engineering (CE)

CURRICULUM

Semester 1

Sl. No	Category	Sub Code	Course Title	Hours / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
THEORY										
1	HS	21 EN T 1 1	Communicative English - I	3	0	0	3	40	60	100
2	BS	21 MA T 1 1	Engineering Mathematics - I	3	1	0	4	40	60	100
3	BS	21 PH T 1 1	Engineering Physics	3	0	0	3	40	60	100
4	BS	21 CY T 1 1	Engineering Chemistry	3	0	0	3	40	60	100
5	ES	21 EE T 1 1	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100
6	ES	21 ME C 1 1	Engineering Graphics	2	0	4	4	40	60	100
PRACTICALS										
7	BS	21 PH L 1 1	Physics and Chemistry Laboratory - I	0	0	2	1	60	40	100
8	ES	21 ME L 1 1	Workshop Practices Laboratory	0	0	3	1	60	40	100
MANDATORY COURSE										
9	MC	21 MC L 1 1	Universal Human values -I	1	0	1	0	100	0	100
			Total credits for Sem	1			22			

Semester 2

Sl. No	Category	Sub Code	Course Title	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	SE	Tot.
THEORY										
1	HS	21 EN T 2 1	Communicative English - II	3	0	0	3	40	60	100
2	BS	21 MA T 2 1	Engineering Mathematics - II	3	1	0	4	40	60	100
3	BS	21 PH T 2 1	Material Science	3	0	0	3	40	60	100
4	ES	21 CS T 1 1	Problem solving and python Programming	3	0	0	3	40	60	100
5	ES	21 ME T 2 1	Engineering Mechanics	3	1	0	4	40	60	100
PRACTICALS										
6	BS	21 PH L 2 1	Physics and Chemistry Laboratory - II	0	0	2	1	60	40	100
7	ES	21 CS L 1 1	Problem Solving and Python ProgrammingLaboratory	0	0	3	1	60	40	100
8	ES	21 ME L 2 2	Computer Aided Drafting and ModelingLaboratory	0	0	3	1	60	40	100
MANDATORY COURSE										
9	MC	21 MC T 0 2	Environmental Science and Engineering	2	0	0	0	100	0	100
			Total credits for Sem	2			20			

Semester		3											
Sl. No	Category	Sub Code					Course Title	Hours / Week			Credits	Max. Marks		
								L	T	P		CA	SE	Tot.
THEORY														
1	BS	21	MA	T	3	1	Transforms and Partial Differential Equations	3	1	0	4	40	60	100
2	PC	21	CE	T	3	1	Construction Materials and Practices	3	0	0	3	40	60	100
3	PC	21	CE	T	3	2	Solid Mechanics	3	0	0	3	40	60	100
4	PC	21	CE	T	3	3	Fluid Mechanics	3	0	0	3	40	60	100
5	PC	21	CE	T	3	4	Surveying and Geomatics	3	0	0	3	40	60	100
PRACTICALS														
6	PC	21	CE	L	3	1	Solid Mechanics Laboratory	0	0	2	1	60	40	100
7	PC	21	CE	L	3	2	Surveying Laboratory	0	0	2	1	60	40	100
8	PC	21	CE	L	3	3	Computer Aided Building Drawing	0	0	2	1	60	40	100
MANDATORY COURSE														
9	MC	21	MC	L	0	3	Essential English for Professionals	0	0	2	0	100	0	100
							Total credits for Sem	3			19			

Semester		4											
Sl. No	Category	Sub Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
THEORY														
1	BS	21	MA	T	4	3	Numerical Methods	3	1	0	4	40	60	100
2	PC	21	CE	T	4	1	Strength of Materials	3	1	0	4	40	60	100
3	PC	21	CE	T	4	2	Hydraulic Engineering	3	1	0	4	40	60	100
4	PC	21	CE	T	4	3	Soil Mechanics	3	0	0	3	40	60	100
5	PC	21	CE	T	4	4	Highway and Pavement Engineering	3	0	0	3	40	60	100
6	PC	21	CE	T	4	5	Physio-Chemical Process for water treatment	3	0	0	3	40	60	100
PRACTICALS														
7	PC	21	CE	L	4	1	Hydraulic Engineering Laboratory	0	0	2	1	60	40	100
8	PC	21	CE	L	4	2	Soil Mechanics and Highway EngineeringLaboratory	0	0	2	1	60	40	100
9	PC	21	CE	L	4	3	Survey Camp	0	0	2	1	100	0	100
MANDATORY COURSE														
10	MC	21	MC	L	0	4	Professional Communication	0	0	2	0	100	0	100
							Total credits for Sem	4			23			

Semester	5										
Sl. No	**Category**	**Sub Code**	**Course Title**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**SE**	**Tot.**
THEORY										
1	PC	21 CE T 5 1	Design of reinforced concrete Elements	3	0	0	3	40	60	100
2	PC	21 CE T 5 2	Structural analysis-I	3	1	0	4	40	60	100
3	PC	21 CE T 5 3	Foundation Engineering	3	0	0	3	40	60	100
4	PC	21 CE T 5 4	Professional Elective-I	3	0	0	3	40	60	100
5	PE	21 CE E X X	Professional Elective-II	3	0	0	3	40	60	100
6	OE		Open Elective-I	3	0	0	3	40	60	100
PRACTICALS										
7	PC	21 CE L 5 1	Concrete technology Laboratory	0	0	2	1	60	40	100
8	PC	21 CE L 5 2	Environmental Engineering Laboratory	0	0	2	1	60	40	100
MANDATORY COURSE										
9	MC	21 MC L 0 9	Communication Skills Laboratory	0	0	2	0	100	0	100
10	MC	21 MC T 0 5	Aptitude and Logical Reasoning	2	0	0	0	100	0	100
			Total credits for Sem	5			21			

Semester	6									
Sl. No	**Category**	**Sub Code**	**Course Title**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**SE**	**Tot.**
THEORY										
1	PC	21 CE T 6 1	Design of reinforced concrete and BrickMasonry structures	3	0	0	3	40	60	100
2	PC	21 CE T 6 2	Structural analysis-II	3	1	0	4	40	60	100
3	PC	21 CE T 6 3	Design of steel Structures	3	1	0	4	40	60	100
4	PE	21 CE E X X	Professional Elective-III	3	0	0	3	40	60	100
5	PE	21 CE E X X	Professional Elective-IV	3	0	0	3	40	60	100
6	OE		Open Elective-II	3	0	0	3	40	60	100
PRACTICALS										
7	PC	21 CE L 6 1	Environmental and Irrigation Engineering-Design and Drawing	0	0	4	2	60	40	100
MANDATORY COURSE										
8	MC	21 MC T 0 7	Arithmetic and Analytical ability	2	0	0	0	100	0	100
			Total credits for Sem	6			22			

Semester	7									
Sl. No	**Category**	**Sub Code**	**Course Title**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**SE**	**Tot**
THEORY										
1	HS	21 CE T 7 1	Engineering Economics and cost analysis	3	0	0	3	40	60	100
2	PC	21 CE T 7 2	Estimation and Quantity surveying	3	0	0	3	40	60	100
3	PE	21 CE T X X	Professional Elective - V	3	0	0	3	40	60	100
4	PE	21 CE T X X	Professional Elective-VI	3	0	0	3	40	60	100
5	OE		Open Elective-III	3	0	0	3	40	60	100
6	HS	21 HS T 1 2	Human Values and Professional Ethics	3	0	0	3	40	60	100
PRACTICALS										
7	PC	21 CE L 7 1	Computer Aided Design and DraftingLaboratory	0	0	2	1	60	40	100
8	PSI	21 CE L 7 2	Design Project	0	0	4	2	40	60	100
9	PSI	21 CE L 7 3	In- plant training	0	0	0	2	100	0	100
MANDATORY COURSE										
10	MC	21 MC T 0 8	Indian Constitution and traditional knowledge	2	0	0	0	100	0	100
			Total credits for Sem	7			23			

Semester	8									
Sl. No	**Category**	**Sub Code**	**Course Title**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**SE**	**Tot.**
1	PSI	21 CE L 8 1	Project Work	0	0	20	10	40	60	100
			Total credits for Sem	8			10			
OPEN ELECTIVES										
1	OE	21CEO01	Civil & Infrastructure Engineering	3	0	0	3	40	60	100
2	OE	21CEO02	Environmental pollution and waste management	3	0	0	3	40	60	100
3	OE	21CEO03	Disaster Management and Mitigation	3	0	0	3	40	60	100
4	OE	21CEO04	Building Services	3	0	0	3	40	60	100
VALUE ADDED COURSES										
1	PSI	21CEV01	Introduction to Revit Architecture	0	0	2	1	60	40	100
2	PSI	21CEV02	Civil Engineering drawing and bar bending schedule	0	0	2	1	60	40	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I (Water Resources)	VERTICAL II (Structures)	VERTICAL III (Environmental and Construction Management)	VERTICAL IV (Construction techniques and Practices)	VERTICAL V (Transportation Engineering)	VERTICAL VI (Diversified Course)
Irrigation Engineering	Finite Element Method	Solid & Hazardous waste Management	Construction Equipment and Machinery	Traffic Engineering and Management	Concrete Technology
Hydrology	Bridge Engineering	Municipal Solid waste Management	Formwork Engineering	Railways, Airports, Docks &Harbour	Ground Improvement Techniques
Water Resources systems Engineering	Structural Dynamics and Earthquake Engineering	Public Health Engineering	Construction Planning, scheduling and control	Infrastructure planning and Design	Remote sensing
Ground Water Engineering	Advanced design of RC Structures	Construction Project Management	Safety in construction	Urban Transportation planning	Structural Geology
Watershed conservation and Management	Prefabricated Structures	Housing planning and Management	Energy Efficient Buildings	Smart Cities	Rainwater Harvesting
Water Quality and Management	Prestressed concrete Structures	Building construction and services	Advanced Construction Techniques	Transportation planning process	Climate Change Adaptation and Mitigation
Urban Water Infrastructure	Advanced Steel structures	Contract Laws and regulations	Repair and Rehabilitation of structures	Intelligent Transport system	Steel concrete Composite structures

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree.

Sl. No	Category	Course Code	Course Title	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	SE	Tot.
VERTICAL 1: WATER RESOURCES										
1	PE	21CEE11	Irrigation Engineering	3	0	0	3	40	60	100
2	PE	21CEE12	Hydrology	3	0	0	3	40	60	100
3	PE	21CEE13	Water Resources systems Engineering	3	0	0	3	40	60	100
4	PE	21CEE14	Ground Water Engineering	3	0	0	3	40	60	100
5	PE	21CEE15	Watershed conservation and Management	3	0	0	3	40	60	100
6	PE	21CEE16	Water Quality and Management	3	0	0	3	40	60	100
7	PE	21CEE17	Urban Water Infrastructure	3	0	0	3	40	60	100
VERTICAL 2: STRUCTURES										
8	PE	21CEE21	Finite Element Method	3	0	0	3	40	60	100
9	PE	21CEE22	Bridge Engineering	3	0	0	3	40	60	100
10	PE	21CEE23	Structural Dynamics and Earthquake	3	0	0	3	40	60	100
11	PE	21CEE24	Advanced design of RC Structures	3	0	0	3	40	60	100
12	PE	21CEE25	Prefabricated Structures	3	0	0	3	40	60	100
13	PE	21CEE26	Prestressed concrete Structures	3	0	0	3	40	60	100
14	PE	21CEE27	Advanced Steel structures	3	0	0	3	40	60	100
VERTICAL 3: ENVIRONMENTAL AND CONSTRUCTION MANAGEMENT										
15	PE	21CEE31	Solid & Hazardous waste Management	3	0	0	3	40	60	100
16	PE	21CEE32	Municipal Solid waste Management	3	0	0	3	40	60	100
17	PE	21CEE33	Public Health Engineering	3	0	0	3	40	60	100
18	PE	21CEE34	Construction Project Management	3	0	0	3	40	60	100
19	PE	21CEE35	Housing planning and Management	3	0	0	3	40	60	100
20	PE	21CEE36	Building construction and services	3	0	0	3	40	60	100
21	PE	21CEE37	Contract Laws and regulations	3	0	0	3	40	60	100
VERTICAL 4: CONSTRUCTION TECHNIQUES AND PRACTICES										
22	PE	21CEE41	Construction Equipment and Machinery	3	0	0	3	40	60	100
23	PE	21CEE42	Formwork Engineering	3	0	0	3	40	60	100
24	PE	21CEE43	Construction Planning, scheduling and control	3	0	0	3	40	60	100
25	PE	21CEE44	Safety in construction	3	0	0	3	40	60	100
26	PE	21CEE45	Energy Efficient Buildings	3	0	0	3	40	60	100
27	PE	21CEE46	Advanced Construction Techniques	3	0	0	3	40	60	100
28	PE	21CEE47	Repair and Rehabilitation of structures	3	0	0	3	40	60	100

VERTICAL 5: TRANSPORTATION ENGINEERING										
29	PE	21CEE51	Traffic Engineering and Management	3	0	0	3	40	60	100
30	PE	21CEE52	Railways, Airports, Docks & Harbour	3	0	0	3	40	60	100
31	PE	21CEE53	Infrastructure planning and Design	3	0	0	3	40	60	100
32	PE	21CEE54	Urban Transportation planning	3	0	0	3	40	60	100
33	PE	21CEE55	Smart Cities	3	0	0	3	40	60	100
34	PE	21CEE56	Transportation planning process	3	0	0	3	40	60	100
35	PE	21CEE57	Intelligent Transport system	3	0	0	3	40	60	100
VERTICAL 6: DIVERSIFIED COURSE										
36	PE	21CEE61	Concrete Technology	3	0	0	3	40	60	100
37	PE	21CEE62	Ground Improvement Techniques	3	0	0	3	40	60	100
38	PE	21CEE63	Remote sensing	3	0	0	3	40	60	100
39	PE	21CEE64	Structural Geology	3	0	0	3	40	60	100
40	PE	21CEE65	Rainwater Harvesting	3	0	0	3	40	60	100
41	PE	21CEE66	Climate Change Adaptation and Mitigation	3	0	0	3	40	60	100
42	PE	21CEE67	Steel concrete Composite structures	3	0	0	3	40	60	100

OPEN ELECTIVES										
Sl.No	Category	Course Code	Course Title	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	SE	Tot.
OFFERED BY DEPARTMENT OF BIO MEDICAL ENGINEERING										
1	OE	21BMO01	Biotelemetry	3	0	0	3	40	60	100
2	OE	21BMO02	Biometric systems and their applications	3	0	0	3	40	60	100
3	OE	21BMO03	Biology for Engineers	3	0	0	3	40	60	100
4	OE	21BMO04	Healthcare Management Systems	3	0	0	3	40	60	100
5	OE	21BMO05	Medical Robotics	3	0	0	3	40	60	100
6	OE	21BMO06	Rapid Prototyping	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF CIVIL ENGINEERING										
1	OE	21CEO01	Civil and Infrastructure Engineering	3	0	0	3	40	60	100
2	OE	21CEO02	Environmental Pollution and waste management	3	0	0	3	40	60	100
3	OE	21CEO03	Disaster Management and Mitigation	3	0	0	3	40	60	100
4	OE	21CEO04	Building Services	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING										
1	OE	21CSO01	Cyber Security	3	0	0	3	40	60	100
2	OE	21CSO02	Web Designing	3	0	0	3	40	60	100
3	OE	21CSO03	Knowledge Management	3	0	0	3	40	60	100
4	OE	21CSO04	Green Computing	3	0	0	3	40	60	100
5*	OE	21CSO05	Principles of Artificial Intelligence	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING										
1	OE	21ECO01	Automotive Electronics	3	0	0	3	40	60	100
2	OE	21ECO02	SCILAB for Engineers	3	0	0	3	40	60	100
3	OE	21ECO03	Satellite Applications	3	0	0	3	40	60	100
4	OE	21ECO04	Consumer Electronics	3	0	0	3	40	60	100
5	OE	21ECO05	Principles of Communication Engineering	3	0	0	3	40	60	100
6	OE	21ECO06	Microcontroller based System Design	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING										
1	OE	21EEO01	PLC and SCADA	3	0	0	3	40	60	100
2	OE	21EEO02	Renewable Energy Sources	3	0	0	3	40	60	100
3	OE	21EEO03	Embedded Real Time System	3	0	0	3	40	60	100
4	OE	21EEO04	Energy Auditing and Conservation	3	0	0	3	40	60	100
5	OE	21EEO05	Electric Vehicles	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING										
1	OE	21MEO01	Industrial Instrumentation	3	0	0	3	40	60	100
2	OE	21MEO02	Product Design and Development	3	0	0	3	40	60	100
3	OE	21MEO03	Sustainable Manufacturing	3	0	0	3	40	60	100
4	OE	21MEO04	Entrepreneurship Development	3	0	0	3	40	60	100
5	OE	21MEO05	Fundamentals of Ergonomics	3	0	0	3	40	60	100
6	OE	21MEO06	Principles of Management and Industrial Psychology	3	0	0	3	40	60	100
7	OE	21MEO07	Safety Measures for Engineers	3	0	0	3	40	60	100

OFFERED BY DEPARTMENT OF MEDICAL ELECTRONICS										
1	OE	21MDO01	Introduction to Medical Electronics	3	0	0	3	40	60	100
2	OE	21MDO02	Hospital Waste Management	3	0	0	3	40	60	100
3	OE	21MDO03	Hospital Information System	3	0	0	3	40	60	100
4	OE	21MDO04	IoT Applications in Healthcare	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF INFORMATION TECHNOLOGY										
1	OE	21ITO01	Basics of Java Programming	3	0	0	3	40	60	100
2	OE	21ITO02	Ethical Hacking	3	0	0	3	40	60	100
3	OE	21ITO03	E-Commerce and Applications	3	0	0	3	40	60	100
4	OE	21ITO04	Basics of Android Application Development	3	0	0	3	40	60	100
5	OE	21ITO05	Principles of Data Science	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF SCIENCE AND HUMANITIES										
1	OE	21GEO01	National Cadet Corps Studies – I	3	0	0	3	40	60	100
2	OE	21GEO02	National Cadet Corps Studies – II	3	0	0	3	40	60	100

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

VERTICALS FOR MINOR DEGREE

Vertical I	**Vertical II**	**Vertical III**	**Vertical IV**	**Vertical V**	**Vertical VI**
Fintech and Block chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**	**Artificial Intelligence**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development	Introduction to Data Science
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management	Principles of Artificial Intelligence
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials	Data Warehousing and Data Mining
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Digital Marketing and Social Network Analytics	Materials for Energy Sustainability	Machine Learning Techniques
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Supply Chain Analytics	Green Technology	Expert Systems
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis	Cognitive Science
-	-	-	-	Integrated Energy Planning for Sustainable Development	Gamification
-	-	-	-	Energy Efficiency for Sustainable Development	-

Sl. No	Category	Course Code	Course Title	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	SE	Tot.
VERTICAL 1: FINTECH AND BLOCK CHAIN										
1	PE	21ITM11	Financial Management	3	0	0	3	40	60	100
2	PE	21ITM12	Fundamentals of Investment	3	0	0	3	40	60	100
3	PE	21ITM13	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	PE	21ITM14	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	PE	21ITM15	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	PE	21ITM16	Introduction to Fintech	3	0	0	3	40	60	100
VERTICAL 2: ENTREPRENEURSHIP										
7	PE	21MEM21	Foundations of Entrepreneurship	3	0	0	3	40	60	100
8	PE	21MEM22	Team Building and Leadership Management for Business	3	0	0	3	40	60	100
9	PE	21MEM23	Creativity and Innovation in Entrepreneurship	3	0	0	3	40	60	100
10	PE	21MEM24	Principles of Marketing Management for Business	3	0	0	3	40	60	100
11	PE	21MEM25	Human Resource Management for	3	0	0	3	40	60	100
12	PE	21MEM26	Financing New Business Ventures	3	0	0	3	40	60	100
VERTICAL 3: PUBLIC ADMINISTRATION										
13	PE	21ECM31	Principles of Public Administration	3	0	0	3	40	60	100
14	PE	21ECM32	Constitution of India	3	0	0	3	40	60	100
15	PE	21ECM33	Public Personnel Administration	3	0	0	3	40	60	100
16	PE	21ECM34	Administrative Theories	3	0	0	3	40	60	100
17	PE	21ECM35	Indian Administrative System	3	0	0	3	40	60	100
18	PE	21ECM36	Public Policy Administration							
VERTICAL 4: BUSINESS DATA ANALYTICS										
19	PE	21CSM41	Statistics for Management	3	0	0	3	40	60	100
20	PE	21CSM42	Datamining for Business Intelligence	3	0	0	3	40	60	100
21	PE	21CSM43	Human Resource Analytics	3	0	0	3	40	60	100
22	PE	21CSM44	Digital Marketing and Social Network Analytics	3	0	0	3	40	60	100
23	PE	21CSM45	Supply Chain Analytics	3	0	0	3	40	60	100
24	PE	21CSM46	Financial Analytics	3	0	0	3	40	60	100

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY										
25	PE	21CEM51	Sustainable infrastructure Development	3	0	0	3	40	60	100
26	PE	21CEM52	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
27	PE	21CEM53	Sustainable Bio Materials	3	0	0	3	40	60	100
28	PE	21CEM54	Materials for Energy Sustainability	3	0	0	3	40	60	100
29	PE	21CEM55	Green Technology	3	0	0	3	40	60	100
30	PE	21CEM56	Environmental Quality Monitoring and	3	0	0	3	40	60	100
31	PE	21CEM57	Integrated Energy Planning for Sustainable Development	3	0	0	3	40	60	100
32	PE	21CEM58	Energy Efficiency for Sustainable Development	3	0	0	3	40	60	100
VERTICAL 6: ARTIFICIAL INTELLIGENCE										
33	PE	21CSM61	Introduction to Data Science	3	0	0	3	40	60	100
34	PE	21CSM62	Principles of Artificial Intelligence	3	0	0	3	40	60	100
35	PE	21CSM63	Data Warehousing and Data Mining	3	0	0	3	40	60	100
36	PE	21CSM64	Machine Learning Techniques	3	0	0	3	40	60	100
37	PE	21CSM65	Expert Systems	3	0	0	3	40	60	100
38	PE	21CSM66	Cognitive Science	3	0	0	3	40	60	100
39	PE	21CSM67	Gamification	3	0	0	3	40	60	100

21ENT11 **COMMUNICATIVE ENGLISH-I** **L T P C**
3 0 0 3

PREAMBLE:
Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-I aims at developing Communication Skills in English essential for the learner to handle English language for a variety of everyday purposes through acquisition of basic grammar and vocabulary along with necessary listening, speaking, reading and writing skills.

Course Outcomes: Upon completion of the course, students will be able to :
1. Use a wide range of vocabulary in oral and written communication.
2. Use correct grammatical structures in speaking and writing.
3. Write clear and coherent informal Passages.
4. Follow different kinds of spoken excerpts and distinguish relevant from irrelevant information, grasp proper sentence pattern and vocabulary through reading
5. Give short informal presentations and participate in classroom discussions

UNIT 1 VOCABULARY **6**
Synonyms and Antonyms- Single Word Substitutes - Use of Abbreviations and Acronyms-Homonyms and Homophones- Business Vocabulary - Commonly Confused Words- Collocation - British and American Vocabulary- Word formation

UNIT 2 GRAMMAR **9**
Comparative Adjectives - Modals -Phrasal Verbs -Tenses – Connectives-Impersonal Passive Voice -Types of Questions -Mechanics of Writing (Editing) -Direct and Indirect Speech- Numerical Adjectives - Gerunds and Infinitives-Expressions of Purpose-Conditional Sentences- Same Word Used as Different Parts of Speech –Subject Verb Agreement

UNIT 3 INFORMAL WRITING **5**
Letter Writing - Informal Letters - Dialogue Writing -Informal Dialogues – Essay Writing-Informal Essays
Movie/Book Reviews

UNIT 4 LANGUAGE ENHANCEMENT THROUGH LISTENING & READING **9**
Listening Comprehension -Listening for General Ideas- Listening to You Tube Documentaries - Listening for Specific Information-Listening for Details-Listening for Vocabulary-BBC Learn English Videos -Reading Comprehension- Understanding General and Specific Information -Sign Post Words-Jumbled Sentences - Finding Topic Sentences and Supporting Arguments - Reading for Vocabulary-Reading News Papers

UNIT 5 LANGUAGE ENHANCEMENT THROUGH SPEAKING **16**
Introduction to IPA-Syllable, Stress, Intonation, etc., -Conversation Starters- Describing Places, People, Things and Pictures -Self Introduction - Narrating Personal Experiences and Incidents-Informal Group Discussions

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sanjay KumarandPushp Lata, "Communication Skills" 2nd Edition, Oxford University Press, New Delhi,2017
2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

REFERENCES:

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012
2. Dhanavel, S.P, "English and Communication Skills for Students of Science and Engineering", 1st Edition, Orient Black Swan, Chennai. 2011
3. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi,2018.

e-RESOURCES:
1. http://www.usingenglish.com
2. https://www.khanacademy.org/humanities/grammar

21MAT11 **ENGINEERING MATHEMATICS I** **L T P C**

3 1 0 4

PREAMBLE:

The course aims at achieving conceptual understanding of topics such as Matrix Algebra and Calculus. The syllabus is designed to provide the skills for modeling engineering problems and understand the role of single variable and multivariables in the discipline of engineering and computer science.

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

1. Evaluate Eigenvalues, eigenvectors and diagonalization of symmetric matrices.
2. Use limit definition, understand differentiation and integration methods.
3. Compute curvature, centre of curvature, evolute and envelope of curves.
4. Express functions of two variables in Taylor's series and compute Jacobians, maximum and minimum values.
5. Apply multiple integrals to determine area in cartesian and polar coordinates and volume in cartesian co ordinates.

UNIT 1 MATRICES **9+3**

Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Statement and application of Cayley Hamilton Theorem – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 CALCULUS **9+3**

Representation of functions – Mathematical Models – New Functions from Old Functions – Graphing Calculators and Computers – The Limit of a Function – Calculating Limits Using the Limit Laws – Continuity – Exponential Growth and Decay – Hyperbolic Functions – Areas and Distances – The Definite Integral – The Fundamental Theorem of Calculus – Improper Integrals.

UNIT 3 GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS **9+3**

Curvature – Radius, Centre and Circle of curvature in Cartesian and Parametric form - Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – Properties of Evolute and Envelope.

UNIT 4 FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian- Properties – Taylor's series expansion for functions of two variables – constrained Maxima and Minima – Lagrange's multipliers with single constraint.

UNIT 5 MULTIPLE INTEGRALS **9+3**

Double integrals in Cartesian and Polar co ordinates- Change of order of Integration – Change of variables from Cartesian to Polar co ordinates – Area as a double integral in Cartesian and Polar form – Volume as a triple integral in Cartesian co ordinates.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics" 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [Sections 1.1, 1.2, 1.3, 1.4, 2.2, 2.3, 2.5, 3.8, 3.11, 5.1, 5.2, 5.3 and 7.8].

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, New Delhi, 2016
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. N.P.Bali,Manish Goyal, "Engineering Mathematics",Lakshmi Publications(PVT) Ltd,4 th edition,2014

e-RESOURCES:

1. http://nptel.ac.in/courses/111105035/"Advanced Engineering Mathematics", Prof. Pratima Panigrahi, Indian Institute of Technology, Kharagpur
2. http://nptel.ac.in/courses/121104017/ " Mathematics-I", Prof. S.K. Ray, Indian Institute of Technology, Kanpur

21PHT11 **ENGINEERING PHYSICS** **L T P C**
3 0 0 3

PREAMBLE:

Ultrasonics forms the basis of Sonar and in the field of medicine for both diagnostics and therapeutic applications. Mechanical properties of Engineering materials are explored for industrial applications such as construction of bridges and railway wagons. Particle and wave nature of quantum particles form the basis of quantum computers .The virtues of lasers are explored in applications such as holography, computers ,space satellites and medicines.

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

1 Demonstrate the knowledge of wave optics in propagation of light waves in optical fibers in communications system.
2 Explain the production of Ultrasonics and its NDT techniques in scanning methods, medical applications.
3 Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications.
4 Explore the dual nature of light waves with quantum theory on Black body radiation and Schrodinger's wave equations.
5 Demonstrate the knowledge on Nd-YAG, CO_2, Semiconductor lasers in industrial applications of welding, heat treatment, cutting, medical treatment and holography.

UNIT 1 WAVES AND OPTICS **9**

Classification of waves-wave equation-(qualitative)-Typical and General wave equation-qualitative analysis of phase and group velocities of waves-Differential equation of simple harmonic motion-Forced oscillations –analysis and classification of damped oscillations through differential equations-coherent sources and incoherent sources.

Superposition principle of Waves- Illustrations-Principle and propagation of light in optical fibers-numerical aperture and acceptance angle-Types of optical fibers (material, refractive index, mode-Application of optical fibers.

UNIT 2 ULTRASONICS **9**

Introduction – Production techniques– Magnetostriction effect– Piezoelectric effect - Piezoelectric generator- detection of ultrasonic waves - properties – cavitations - velocity measurement – acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - non destructive testing – pulse echo system, through transmission and reflection modes - A,B and C scan - medical applications - sonograms.

UNIT 3 MECHANICAL AND THERMAL PROPERTIES **9**

Elasticity – Stress-strain diagram and its uses – factors affecting elastic modulus and tensile strength. Torsional stress and deformations – twisting couple – torsion pendulum: theory and experiment – bending of beams. Bending moment – cantilever, Young's Modulus by Uniform and non-uniform bending: theory and experiment – I-shaped girders.

Modes of heat transfer -thermal conductivity- Specific heat-Newton's law of cooling - Forbe's and Lee's disc method: theory and experiment– thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters

UNIT 4 MODERN PHYSICS **9**

Wave- particle duality, de-Broglie matter waves, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Black body radiation – Planck's theory (derivation) – deduction of Wien's displacement law and Rayleigh – Jeans' law from Planck's theory — Matter waves – concept of operator-Eigen value and Eigen function- Physical significance of wave function -Schrodinger's time independent wave equation — Particle in a one dimensional box ,qualitative explanation on wave equation and energy value in three dimensional box.

UNIT 5 LASER **9**

Introduction – principle of spontaneous emission and stimulated emission, population inversion, pumping. Einstein's coefficients - derivation. Types of lasers- Nd-YAG-CO_2, Semiconductor lasers (homojunction & heterojunction) – Industrial applications - lasers in welding, heat treatment, cutting- medical applications- holography-construction and reconstruction-Safety classes of laser.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai publishers, 2009.
2. Mani Naidu S., "Engineering Physics", 2nd Edition, Pearson Publishing, 2011.

REFERENCES

1. Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 9th Edition, Thomson Brooks Cole, 2013
2. Young H.D., Freedman R.A. and Ford A.L., "Sears and Zemansky's University Physics with Modern Physics", 13th Edition, Pearson India, 2013.
3. Tipler P.A. and Mosca G.P., "Physics for Scientists and Engineers with Modern Physics", 6th Edition, W.H.Freeman, 2007.

e-RESOURCES:

1. http://nptel.ac.in/courses/115101003 , "Atomic and Molecular Physics" – Dr. T. Kundu, IIT Bombay.
2. https://www.khanacademy.org/science/physics/quantum-physics

21CYT11 **ENGINEERING CHEMISTRY** **L T P C**

3 0 0 3

PREAMBLE:

The study of water technology enables engineers to acquire skills to make the simple design calculation of drinking water as well as industrial water treatment. Electrochemistry and corrosion explain the fundamentals, corrosion prevention, identification and implementation for solving electrochemical and corrosion problems. The study of energy storage devices exposes some of the most commonly used energy storage technologies. Instrumental methods and analysis describe basic concepts and promote to solve real analytical problems. Studies of Nanochemistry span many areas as assemblies significant new structures like nanowire, nanotube and lab-in-chip devices.

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

1. Evaluate the process to purify hard water using ion-exchange, zeolite and reverse osmosis methods.
2. Compare and contrast corrosion control methods and analyze the performance of alkaline, lead acid and fuel cells.
3. Analyze the metal ion concentration for solid and liquid samples with the aid of flame photometry, calorimetry, UV and IR spectroscopy.
4. Categorize different types of polymers to select injection or compression fabrication method. .
5. Analyze the synthesis of nanoparticles using top down and bottom up process.

UNIT 1 WATER TECHNOLOGY **9**

Hardness – types, estimation by EDTA method, Boiler troubles – scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion, Internal conditioning - carbonate, phosphate and calgon conditioning, External conditioning – zeolite and demineralisation process, Desalination – reverse osmosis method.

UNIT 2 ELECROCHEMISTRY AND CORROSION **9**

Electrochemistry –cell terminology, EMF series. Corrosion – chemical (corrosion by O_2, H_2 and liquid-metal) and electrochemical corrosion (H_2 evolution and absorption of O_2), Corrosion control – sacrificial anode, Impressed current method and electroless plating. Application of electrochemistry-primary battery (alkaline battery), secondary battery (lead acid battery) and fuel cell (H_2-O_2 fuel cell)

UNIT 3 INSTRUMENTAL METHODS AND ANALYSIS **9**

Basic principles – Beer-lamberts law, instrumentation with block diagram and applications of calorimetry (estimation of Fe^{2+}), UV-Visible spectroscopy, infrared spectroscopy and flame photometry (estimation of sodium).

UNIT 4 HIGH POLYMERS **9**

Polymers – classification (based on molecular forces-thermoplastics and thermosetting plastics), polymerisation – types, mechanism (Free radical only),Compounding and fabrication – compression, injection, Composites-definition, types, polymer matrix composites-FRP only.

Real time applications of thermoplastics (PVC, Teflon), thermosetting plastics (nylon, epoxy resin)

UNIT 5 NANOCHEMISTRY **9**

Basics – distinction between molecules, nanoparticles and bulk materials, Nanoparticles – nano cluster, nano rod, nanotube (CNT) and nanowire, Synthesis – top down process (laser ablation and electro-deposition),bottom up process (thermolysis – hydrothermal, solvothermal), Nanoparticles –properties and applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. P.C Jain and Monika Jain, "Engineering Chemistry", 16th edition, DanpatRai publishing company (P) Ltd, New Delhi, 2015
2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, "Engineering Chemistry", 3rd edition. PHI Learning PVT., LTD, New Delhi, 2014.

REFERENCES:

1. S.S.Dara, "A Text book of Engineering Chemistry", 12th Edition, S.Chand & Company Ltd., New Delhi, 2010.
2. "Engineering chemistry", 2nd edition, Wiley India private Ltd. New Delhi, 2014.
3. V.R.Gowariker, N.V.Viswanathan and Jayadevsreedhar, "Polymer Science" 2nd edition, New age International publishers, New Delhi, 2015.

e-RESOURCES:

1. http://nptel.ac.in/courses/113104061/ ,"Environmental Degradation of Materials" - Dr.KallolMondal, Department of Metallurgy and Material Science, IIT Kanpur
2. http://nptel.ac.in/courses/113105028/ **,** "Science and Technology of Polymers"- Prof.B.Adhikari, Department of Metallurgical & Materials Engineering, IIT Kharagpur

21EET11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

PREAMBLE:
The course covers the fundamentals of basic electrical circuit parameters of both ac and dc circuits and the characteristics of motors and generators. The basics of semiconductor devices and logic gates provides the necessary initiative for the students to acquire the knowledge in basic electronics.

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

1 Analyze the various DC circuits and find the circuit parameters.
2 Describe the principles of AC fundamentals.
3 Illustrate the construction and working principle of DC machines.
4 Explain the basics of semiconductor devices and its applications.
5 Explain the basics of Number systems and Logic gates.

UNIT 1 ELECTRICAL CIRCUITS – DC 9

Definition of Electrical Circuit Parameters - voltage – current - power and energy. Elements of DC Circuits - DC voltage / Current Sources. Calculation of Resistance and Current in series and parallel circuit– Star-Delta transformation of Resistance. Ohm's Law, Kirchhoff's Laws and its applications - Simple Problems in Mesh and Nodal analysis. Construction and working principle of Permanent Magnet Moving Coil Instruments.

UNIT 2 ELECTRICAL CIRCUITS – AC 9

AC Circuit Terminologies - RMS and Average value of Sinusoidal waveform – Form Factor - Peak Factor - Power Factor - Definition of impedance and admittance – Phasor diagram - Analysis of R, L, C, RL, RC, RLC circuits. Construction and working principle of Moving iron Instruments. Introduction to Three phase system - Star and Delta Connection.

UNIT 3 ELECTRICAL MACHINES 9

Review of Laws of Electromagnetic Induction – Fleming's Right and Left hand rules – Lenz's law. DC Generator - Construction - Working principle - Characteristics of DC Shunt Generator. DC Motor - Construction - Working principle – Characteristics and applications of DC Shunt Motor - AC transmission and distribution system (Single line diagram).

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS 9

PN junction Diode and its Characteristics - Zener Diode and its Characteristics – Half and Full wave Rectifiers – Voltage regulation. Bipolar Junction Transistor - CE configuration and its characteristics – BJT as an amplifier.

UNIT 5 DIGITAL ELECTRONICS 9

Boolean Algebra - Theorems and Laws - De-Morgan's theorem – Logic Gates – Universal Gates - Implementation of Boolean functions. Binary Arithmetic - Addition – Subtraction – Multiplication - Division – BCD addition - Half adder and Full adder circuits.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Muthusubramanian R and Salivahanan S, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 1st Edition, 2014.
2. Mittle V N and Aravind Mittal, "Basic Electrical engineering", McGraw Hill Education, 2nd Edition, 2006.

REFERENCES:

1. V.K.Mehta and Rohit Mehta, "Principles of Electrical Engineering and Electronics", S.Chand & Company Ltd, 2015.
2. Sedha R.S.,"Applied Electronics",S.Chand & Company Ltd,2006.
3. Thomas L.Floyd.,"Digital Fundamentals",Pearson Education,Prentice Hall,Tenth Edition,2010.

E-RESOURCES:

1. http://nptel.ac.in/courses/117106101/ , "Basic Electrical Circuits", Prof. Nagendra Krishnapura, IIT, Madras.
2. http://nptel.ac.in/downloads/108105053/ , "Basic Electrical Technology", Prof. Dr. L. Umanand, IIS, Bangalore.
3. http://nptel.ac.in/courses/117103063/ , "Basic Electronics", Dr. Chitralekha Mahanta, IIT, Guwahati.

21MEC11 **ENGINEERING GRAPHICS** **L T P C**
2 0 4 4

PREAMBLE:

The knowledge of Engineering graphics is essential for the Engineering graduates in proposing new product designs through drawings and interpreting data from existing drawings. Engineering Design inculcates into an Engineer the creativity and knowledge on various aspects to be considered while designing and realizing the functional products and processes. This course deals with Engineering curves, orthographic and pictorial projections, sectional views and development of surfaces.

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

1. Draw the various conic sections and Engineering curves.
2. Sketch the orthographic views from given pictorial views and projections of lines.
3. Draw the projections of planes and solids kept in various positions.
4. Sketch sectioned views of solids and development of surfaces.
5. Draw the isometric and perspective projections of simple solids.

UNIT 1 INTRODUCTION AND PLANE CURVES 12

Importance of graphics in Engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lines, lettering and dimensioning-Basic geometrical constructions. (PRACTICE ONLY AND NOT FOR EXAMINATIONS).

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

UNIT 2 PROJECTION OF POINTS, LINES AND FREE HAND SKETCHING 12

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

Visualization concepts- Free hand sketching – Conversion of Isometric view to orthographic views.

UNIT 3 PROJECTION OF PLANE SURFACES AND SOLIDS 12

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Projection of simple solids- Cube, prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane and parallel to the other by rotating object method.

UNIT 4 SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of above solids in simple vertical position when cut by a cutting plane which is inclined to one of the reference planes and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids in simple vertical position – Cube, prisms, pyramids, cylinder and cone.

UNIT 5 ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – Isometric scale –Isometric projections of simple solids - Prisms, pyramids, cylinder and cone-Combination of two solid objects in simple vertical position.

Perspective projection of simple solids-Cube, prisms, pyramids, cylinder and cone, by visual ray method when axis is either parallel or perpendicular to ground plane.

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Ltd, 13th Edition, 2015.

2 Jeyapoovan T. , "Engineering Graphics with AUTOCAD", Vikas Publishing House Pvt., Ltd., 7th Edition, 2015.

REFERENCES:

1 Bhatt N.D., Panchal, V.M. and Ingle P.R., "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd Edition, 2014.

2 Parthasarathy N.S. and Vela Murali, "Engineering Drawing", Oxford University Press, 1st Edition, Second Impression 2015.

3 Luzzader W..J. and Duff J.M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

e-RESOURCES:

1. http://nptel.ac.in/courses/105104148, "Engineering Graphics" - Dr. Nihar Ranjan Patra , IIT Kanpur
2. http://cfd.annauniv.edu/webcontent.htm, "Engineering Graphics" - Dr. Velamurali

21PHL11 **PHYSICS AND CHEMISTRY LABORATORY -I** **L T P C**
0 0 3 1

PREAMBLE:

In the present course related to the lab, understanding of physics concepts applied in optics, thermal and properties of matter has been developed. The necessary practical skills in the determination of water quality parameters and strength of acid has been explored.

Course Outcomes:

1. Experiment and determine the physical characteristics of given solid materials.
2. Experiment and determine the velocity of ultrasonic waves through water medium.
3. Experiment and determine the optical property of light sources.
4. Experiment and estimate hydroxyl, carbonate and bicarbonate alkalinity using HCL in water sample.
5. Experiment and determine the amount of total, temporary, permanent hardness of water using EDTA by complexometric titration.
6. Experiment and determine the amount of iron content present in the given sample using potentiometer, spectrophotometer and strength of acid using conductivity meter.

PHYSICS LABORATORY – I

(Any Five Experiments)

LIST OF EXPERIMENTS

1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of Planck's constant by photocell method

CHEMISTRY LABORATORY – I

LIST OF EXPERIMENTS

1. Determination of alkalinity in water sample
2. Determination of total, temporary and permanent hardness of water by EDTA method.
3. Determination of iron content of the water sample using spectrophotometer (1,10-phenanthroline /thiocyanate method).
4. Determination of iron content of the given solution using a potentiometer
5. Determination of strength of acid using conductivity meter.

TOTAL : 30 PERIODS

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

21MEL11 **WORKSHOP PRACTICES LABORATORY** **L T P C**
0 0 3 1

PREAMBLE:

Workshop practices give hands-on training practice to Engineering students. This course includes carpentry, plumbing, welding, sheet metal forming and welding exercises. Also, this course will inculcate in the students the habit of selecting right tools, planning the job and its execution.

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

1. Fabricate various joints by carpentry and to prepare plumbing line assemblies.
2. Fabricate various joints through arc welding and gas welding processes.
3. Perform metal forming and basic machining operations.
4. Construct various types of domestic wiring and measure the various electrical parameters.
5. Develop and test circuits with active elements and verify truth table of logic gates.

GROUP A

CIVIL **9**

Plumbing Works:

- Study of plumbing tools, pipeline joints, its location, functions and safety aspects.

1. a. Distribution of water from sump to overhead tank and return to home tap with bye pass connection.
   b. Distribution of water in mixed pipes.

Carpentry using Power Tools only:

- Study of the carpentry tools, joints and processes in roofs, doors, windows and furniture and safety precautions.

Hands-on-exercise:

1. Tee Lap joint
2. Dove tail joint

MECHANICAL **15**

Welding:

1. Arc welding - Lap joint
2. Arc welding - Tee joint

Basic Machining:

3. Simple Turning and Facing
4. Drilling and Tapping

Sheet Metal Work- Forming & Bending:

5. Model making - Tray / Funnel

Study Experiments:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration:

- Gas welding practice

GROUP B

ELECTRICAL **12**

1. Residential house wiring using switches, fuse, indicator and lamps.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Reading of voltage, current, power, energy and other parameters with 1 phase digital energy meter.
5. Measurement of earth resistance.

ELECTRONICS **9**

1. Identification and Study of Electronic components and equipments – Resistors, capacitors, inductors, colour coding and measurement.
2. Measurement of AC signal parameters (peak-peak, RMS value, period, frequency) using CRO.
3. Verification of the truth tables of logic gates: AND, OR, XOR and NOT.
4. Construction of Half Wave and Full Wave Rectifiers and study their output waveforms.
5. Soldering practice – Using general purpose PCB.

TOTAL : 45 PERIODS

REFERENCES: Manual prepared by the faculty of Mechanical Engineering Department, VCET.

e-RESOURCES: http://vlabs.iitkgp.ernet.in/be/#

21MCL11 **UNIVERSAL HUMAN VALUES - I** **L T P C**
1 0 1 0

PREAMBLE:
Universal Human Values is a life skill necessary for all to develop physical health and factors for strengthening life force. This course aims to expose the students in the areas of mediation and impart the knowledge on social virtues and morals..

Course Outcomes: Upon completion of the course, students will be able to:
1. Demonstrate the knowledge on physical health
2. Discuss the various factors for strengthening life force
3. Classify mind waves and explain the benefits of meditation
4. Explain individual and social virtues
5. Identify and explain the importance of morals.

UNIT 1 Physical Health **6**

SKY – Introduction – Education as a means for youth empowerment – Greatness of Education – Yoga for Youth Empowerment – Simplified Physical Exercises: Explanation – Hand, Leg, Breathing and Eye exercises – Kapalabathi, Makarasanam, Massaging, Acupressure and Relaxation practices –Yogasanas- Explanation – Benefits.

UNIT 2 Strengthening Life Forces **6**

Reasons for Diseases : Natural Reasons (Hereditary, Planetary Position, Natural Calamities and Climatic changes) – Artificial Reasons (Food, Thought, Deed). Philosophy of Kayakalpa: Physical Body –Life Force – Biomagnetism – Mind. Maintaining Youthfulness – Postponing Aging – Transformation of Food into seven Body constituents.

UNIT 3 Wellness of Mind **6**

Classification of Mind Waves – Beta, Alpha, Theeta, Delta – Agna Meditation – Benefits. Shanthi Mediation – Benefits. Thuriya Meditation – Benefits. Blessing and its Benefits: Auto Suggestion – Blessing the family and others – Blessings the World – Divine Protection.

UNIT 4 Virtues **6**

Individual Virtues : Self Control – Self Confidence – Speaking Truth – Contentment – Humility – Mind Control. Tolerance – Adjustment – Sacrifice – Forgiveness. Cleanliness (Body, Dress, Surrounding)-External, Mental, Inner Cleanliness. **Societal Virtues :** Ahimsa – Services, Patriotism – Equality, Respecting the parents and elders – Caring for them – Respecting Teachers. Punctuality – Time Management.

UNIT 5 Morals **6**

Importance of introspection: I and Mine (Ego, Possessiveness), Six Temperaments: Greed – Anger – Miserliness – Immoral Sexual Passion – Inferior Superior complex – Vengeance. Maneuvering the Six Temperaments: Contentment – Tolerance – Charity – Chastity – Parity – Forgiveness. Five important Benefits of Meditation: Perspicacity – Magnanimity – Adaptability – Receptivity – Creativity. (Enhancing memory) (Effective Examination Preparation)

TOTAL : 30 PERIODS

TEXT BOOKS:

1. "Yoga for Youth Empowerment" compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi, 1st Edition 2016.
2. "Yoga for Human Excellence", compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi 1st Edition 2009.

e-RESOURCE:
1. www.online.vethathiri.edu.in "online in (Virtual) Programme on Yoga and Human Excellence".

21ENT21 **COMMUNICATIVE ENGLISH-II** **L T P C**
3 0 0 3

PREAMBLE:
Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-II aims at developing Communication Skills in English essential for expressing the ideas through speaking and writing in different social, academic and professional contexts.

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

1. Start, maintain and close a conversation in a variety of contexts including formal/informal and telephonic conversation.
2. Use structurally correct expressions and conversations.
3. Speak fluently using phrasal verbs and Idiomatic Expressions by recognizing and rectifying own pronunciation and intonation problems.
4. Speak fluently using a wide range of vocabulary.
5. Communicate effectively by using business correspondence structures.

UNIT 1 EFFECTIVE SPEAKING -BASIC LANGUAGE CHUNKS 10

Conversational Starters – Closing a Conversation - Greeting and Leave Taking - Introducing Oneself - Introducing Others - Making Request - Offering Help - Expressing Gratitude -Extending Invitation - – Conveying Wishes – Encouraging Words -Seeking Permission – Granting Permission-Making Complaints - Seeking Apology - Making Interruption - Expressing Possibility- Expressing Agreement and Disagreement - Expressing Hesitation -Asking for Directions and Giving Directions - Giving Instructions- Questions and Expressions with Time – Checking for Understanding -Showing Interest -Expressing Likes and Dislikes

UNIT 2 EFFECTIVE SPEAKING –ADVANCED LANGUAGE CHUNKS 10

Expressing Personal Opinion - Expressing Feelings - Accepting Responsibility - Giving Clarifications - Tag Questions - Giving Comments – Giving Advice – Making Suggestions- –Making Comparisons – Analyzing Problems- Exploring Options – Making Classifications and Elaborations - Speaking Hypothetically-- Discussing Plans-Making Negotiations-Making Presentations-Telephone Etiquette - Telephone Conversation

UNIT 3 EFFECTIVE SPEAKING - PHRASAL VERBS AND IDIOMATIC EXPRESSIONS 3

Most useful Phrasal Verbs related to Self-Introduction-Idiomatic Expressions related to Person, Time and Action

UNIT 4 EFFECTIVE SPEAKING – VOCABULARY ENRICHMENT 10

Talking about Abilities – Travel – Shopping – Climate -Commuting – Distance – Food – Occupation – Parties and Festivals – Daily Routine – Clothing – Hobbies – Favorites- Family – Buying and Selling- Schedules and Plans

NIT 5 BUSINESS WRITING 12

Writing Instructions - Recommendations - Checklist - Tour Itinerary -Writing Slogans - E- mail Writing - Single Line Definitions - Process Description – SMS - Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables - Business Letters - Calling for Quotations, Placing Orders, Letter of Complaint, Letter of Clarification - Agenda and Meeting Minutes - Cover Letter with Résumé - Report Writing - Accident Report, Industrial Visit Report, Survey Report and Feasibility Report- Summary Writing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sanjay KumarandPushp Lata, “Communication Skills” 2nd Edition, Oxford University Press, New Delhi.2017.
2. J.K.Gangal, “A Practical Course in Spoken English” 1st Edition PH1 Learning Private Limited, Delhi,2014.

REFERENCES:

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, “Resonance English for Engineers and Technologists”.Cambridge University Press, 1st Edition, Foundation Books,New Delhi, 2013.
2. Dr.MahendraSarawat, “Speak English Fluently” UpkarPrakashan Publishers, 1st Edition,Agra,2010.
3. S.Sumant,Joyce Pereira, “Technical English”,Vijay Nicole imprints Private Limited,1st EditionChennai,2017.

e-RESOURCES:

1. https://www.fluentu.com/Blog/english/english-small-talk/
2. http://www.britishcouncil.com

21MAT21 **ENGINEERING MATHEMATICS – II** **L T P C**

3 1 0 4

PREAMBLE:

Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals. Complex Integration approach is very useful to evaluate many improper integrals of a real variable. The Laplace transform method is a powerful method for solving linear ODEs and corresponding initial value problems as well as systems of ODEs arising in Engineering. The knowledge of transformations is to create a new domain in which it is easier to handle the problem that is being investigated.

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

1. Compute gradient, directional derivative by vector differentiation and determine line integrals, surface integrals and volume integrals by vector integration.
2. Construct analytic functions and transforms the analytic functions from one domain to another using conformal mapping.
3. Classify the singularities, find Laurent's series for analytic functions and compute complex integrals using Cauchy's integral theorem and Cauchy's Residue theorem.
4. Solve linear higher order differential equations with constant and variable coefficients
5. Solve linear second order ordinary differential equations with constant coefficients using the properties of Laplace Transforms.

UNIT 1 VECTOR CALCULUS 9+3

Vector Differentiation: Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration: Line, Surface and Volume Integrals -Green's theorem in a plane, Gauss Divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving squares, rectangles, cubes and rectangular parallelepipeds.

UNIT 2 ANALYTIC FUNCTIONS 9+3

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

UNIT 3 COMPLEX INTEGRATION 9+3

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proof) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem(excluding proof) – Application of residue theorem to evaluate real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

UNIT 4 ORDINARY DIFFERENTIAL EQUATIONS 9+3

Linear higher order differential equations with constant coefficients – Method of variation of Parameters – Cauchy's and Legendre's linear differential equations – Simultaneous first order linear differential equations with constant coefficients.

UNIT 5 LAPLACE TRANSFORMS 9+3

Laplace transform: Sufficient conditions – Transform of elementary functions – Basic Properties – Transforms of derivatives and integrals of functions — Transform of periodic functions

Inverse Laplace transform: Standard results – Statement of Convolution theorem and its applications – Initial and final value theorems – Solution of linear second order ODE with constant coefficients using Laplace transformation techniques.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics'', Khanna Publishers, 43rd Edition, New Delhi, 2014.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, New Delhi, 2016

REFERENCES:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Veerarajan T., "Engineering Mathematics (I Year)", 3 rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Higher Engineering Mathematics", S.Chand & Company Limited, Chennai, 2016.

e-RESOURCES:

1. http://nptel.ac.in/courses/121107036/ "Mathematics-II", Prof. Tanuja Srivastava, Department of Mathematics, Indian Institute of Technology, Roorkee.
2. http://nptel.ac.in/courses/121107037/ "Mathematics – III", Prof. Dr. P. N. Agrawal , Indian Institute of Technology, Roorkee

21PHT21 **MATERIALS SCIENCE** **L T P C**

3 0 0 3

Preamble:

A Knowledge about the electronic structure of metals, semiconductors and dielectrics has manifested us a technology to design materials of desired properties. The properties of superconductors, magnetic materials and engineering materials like metallic glasses, shape memory alloys, biomaterials and nanomaterials has emerged as a technology, contributing to advances in medicine ,electronics,astronomy,transportation and experimental science.

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

1. Explain the behaviour of conducting materials based on classical and Quantum theory.
2. Demonstrate the knowledge of semiconductors with their carrier concentration and hall effect.
3. Describe the types of magnetic material and applications of superconducting materials.
4. Discuss the types of Polaraisation, breakdown and the applications of Dielectric materials.
5. Explain the preparation, properties and applications of metallic glasses, Shape memory alloy, Nanomaterials and Biomaterials.

UNIT 1 CONDUCTING MATERIALS **9**

Conductors – Classical free electron theory of metals – Electrical and thermal conductivity -Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory –Fermi distribution function – Effect of temperature on Fermi function – Density of energy states –Carrier concentration in metals.

UNIT 2 SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination –Types of semiconductor- Derivation of carrier concentration in n-type and p-type semiconductor– Variation of Fermi level with temperature and impurity concentration — Hall effect – Determination of Hall coefficient – Applications.

UNIT 3 MAGNETIC AND SUPERCONDUCTING MATERIALS **9**

Origin of magnetic moment – Bohr magneton – Comparison of dia, Para and Ferro magnetism –Langevin theory of Paramagnetism(Qualitative) -Domain theory – Hysteresis – Soft and hard magnetic materials – Antiferromagnetic materials.
Superconductivity : Properties – Type I and type II superconductors –BCS theory of superconductivity(qualitative) – High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT 4 DIELECTRIC MATERIALS **9**

Electrical susceptibility – Dielectric constant – Electronic, ionic, orientational and space charge polarization – Debye equation-Frequency and temperature dependence of polarisation – Internal field – Claussius –Mosotti relation (derivation) – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor and transformer) – Ferroelectricity and applications.

UNIT 5 ADVANCED ENGINEERING MATERIALS **9**

Metallic glasses: Preparation, properties and applications – Shape memory alloys (SMA): Characteristics, properties of Ni-Ti alloy, applications –Concept of Nanomaterials – Synthesis routes – Pulsed laser deposition – Chemical vapour deposition – Applications – Role of Polymers and Composites.

TOTAL : *45* PERIODS

TEXT BOOKS:

1. Palanisamy P.K, “Materials Science”, 2nd Edition, Scitech publications (India) Pvt. Ltd., Chennai, 2007.
2. S.O.Pillai “Solid State Physics”,6th Edition,New Age International(P) Ltd,Publishers New Delhi,2010.

REFERENCES:

1. Balasubramaniam R, “Callister's Materials Science and Engineering”, 2nd Edition, Wiley-India 2014.
2. Richard J.D.Tilley,”Understanding Solids”,2nd Edition, John Wiley&Sons –India, 2013
3. Charles P. Poole and Frank J.Owens, “Introduction to Nanotechnology”, 1st Edition, Wiley, New Delhi, 2007.

e-RESOURCES:

1. http://nptel.ac.in/courses/122102008 , “Materials Science” – Dr. S. K. Gupta, IIT Delhi
2. https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields

21CST21 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

PREAMBLE:

Python is easy to use, powerful, and versatile, making it a great choice for beginners and experts alike. Python's readability makes it a great first programming language — it allows you to think like a programmer and not waste time understanding the mysterious syntax that other programming languages can require. The syntax in Python helps the programmers to do coding in fewer steps**.**Python is widely used in bigger organizations because of its multiple programming paradigms.

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

1. Develop algorithms, flowcharts and pseudo codes for a given problem.
2. Develop Python programs usingdecision control statements for solving given problems.
3. Develop functions, modules and packages using Python for solving given problems.
4. Write programs using stringhandling features in Python for solving given problems.
5. Create Python programs using list, tuple, dictionaries and sets to solve given problems.

UNIT 1 INTRODUCTION 9

Generation, Characteristics and Classification of Computers – Organization of Computers – Problem Solving Strategies – Program Design Tools: Algorithms, Flowcharts and Pseudocodes – Types of Errors.

UNIT 2 DATA TYPES AND CONTROL STATEMENTS 9

Features of Python – Literal Constants – Variables and Identifiers – Data Types – Input operation – Comments – Reserved words – Indentation – Operators and Expressions – Expressions in Python – Operations on Strings – Type conversion – Decision Control Statements: Selection / Conditional Branching – Loop Structures / Iterative Statements – Nested Loops – break – continue – pass – else statements.

UNIT 3 FUNCTIONS, MODULES AND PACKAGES 9

Need for functions – Function definition – Function call – Variable Scope and lifetime – return statement – function arguments : required, keyword, default and variable length arguments–Lambda functions – recursive functions – modules – packages in Python – Standard library modules – function redefinition.

UNIT 4 STRING, LIST AND SET 9

String manipulations – String formatting – built in methods and functions – slice operation – string comparison and iteration. List: Basic list operations – nested lists – cloning lists – List methods – Looping in lists. Sets: Creating sets – set operations.

UNIT 5 TUPLES , DICTIONARY AND FILES 9

Tuples: Creating and accessing values – Basic Tuple operations – Tuple assignment – tuples returning multiple values – nested tuples. Dictionary: Creating and Accessing values – Sorting –Looping – Dictionary functions and methods. File: Types of files – opening, closing, reading and writing files.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, 2017.

REFERENCES:

1. Guido van Rossum and Fred L.Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2", Network theory ltd., 2011.
2. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

e-RESOURCES:

1. https://swayam.gov.in/course/4178-spoken-tutorial-python-english,"Introduction to Python", Prof. Prabhu Ramachandran, IIT Bombay.
2. https://onlinecourses.nptel.ac.in/noc21_cs21, "Programming, Data Structures And Algorithms Using Python", Prof.Madhavan Mukund, IIT-Bombay.

21MET21 **ENGINEERING MECHANICS** **L T P C**
3 2 0 4

PREAMBLE:

Engineering Mechanics deals with the state of rest or motion of the bodies subjected to the action of forces. This course is mainly concerned about the rigid body mechanics, which forms the basis for the design and analysis of the various structural and mechanical devices encountered in Engineering. This course is subdivided into Statics and Dynamics. Statics deals with the study of bodies under rest or uniform motion while Dynamics deals with the bodies under accelerated motion.

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

1. Analyze the static equilibrium of particles under the influence of forces.
2. Draw free body diagrams and to solve problems related to the static equilibrium of rigid bodies.
3. Locate the centroid of plane areas and centre of mass of solids and to compute moment of inertia.
4. Demonstrate the knowledge on friction and its influence on the equilibrium of bodies.
5. Determine the displacement, velocity and acceleration of the rigid bodies subjected to dynamic forces.

UNIT 1 BASICS AND STATICS OF PARTICLES **12**

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

UNIT 2 EQUILIBRIUM OF RIGID BODIES **12**

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

UNIT 3 PROPERTIES OF SURFACES AND SOLIDS **12**

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

UNIT 4 FRICTION **12**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction, ladder friction, screw friction, belt friction, Rolling resistance.

UNIT 5 DYNAMICS OF PARTICLES AND RIGID BODIES **12**

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

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Beer F.P et.al., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 10th Edition, Tata McGraw Hill Education India Pvt. Ltd., New Delhi, 2014.
2. Kumaravelan R. and Yugananth P., "Engineering Mechanics", 2nd Edition, Scitech Publications, 2015.

REFERENCES:

1. Vela Murali, "Engineering Mechanics", 1st Edition 11th Impression, Oxford University Press, 2016.
2. Timoshenko S, Young D H , SukumarPati and Rao J V, "Engineering Mechanics (in SI Units)" , 5th Edition, McGrawhill Education, 2013.
3. Kottiswaran N., "Engineering Mechanics Statics and Dynamics", 10th Edition, Sri Balaji Publications Pvt. Ltd., 2013.

e-RESOURCES:

1. http://nptel.ac.in/courses/121104015. Engineering Mechanics - Prof. Manoj K Harbola ,IIT Kanpur.
2. https://www.coursera.org/course/statics1

21PHL21 **PHYSICS AND CHEMISTRY LABORATORY- II** **L T P C**

0 0 3 1

Preamble :

The understanding of characteristics of solids and liquids and properties of semiconducting materials has been explored. The practical skills in the instrumental methods for quantitative estimation of metal ions content has been the main focus.

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

1. Experiment and determine the physical characteristics of given solid material.
2. Experiment and determine the Energy band gap of the given semiconducting materials.
3. Experiment and determine the physical characteristics of given liquid.
4. Experiment and estimate dissolved oxygen content using alkali iodide solution by winkler's method, amount of copper content using EDTA by complexometric titration.
5. Experiment and test chloride content present in the waste water by titrating against silver nitrate using Mohr's method.
6. Experiment and determine the concentration of metals and ions present in the wastewater with the aid of flame photometer and pH meter.

PHYSICS LABORATORY II
(Any Five Experiments)

LIST OF EXPERIMENTS

1. Determination of Young's modulus by uniform bending method.
2. Determination of band gap of a semiconductor.
3. Determination of coefficient of viscosity of a liquid – Poiseuille's method.
4. Determination of thickness of a thin wire – Air wedge method.
5. Determination of rigidity modulus – Torsion pendulum.
6. Determination of Hysteresis of a ferromagnetic material –Deflection magnetometer

CHEMISTRY LABORATORY II

LIST OF EXPERIMENTS

1. Determination of Dissolved Oxygen content of waste water sample by Winkler's method
2. Determination of chloride content of wastewater sample by Argentometric method.
3. Determination of acid strength in waste water using pH meter.
4. Estimation of dissolved metal ions present in wastewater using flame photometer.
5. Estimation of dissolved metal ions(copper) present in wastewater by EDTA method.

TOTAL : 30 PERIODS

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

PREAMBLE:
Python is a dynamic and powerful programming language that focuses on code readability. The Python language has diversified application in the software development companies such as in gaming, web frameworks and applications, language development, prototyping, graphic design applications, etc. This provides the language a higher plethora over other programming languages used in the industry.

Course Outcomes: Upon completion of the course, students will be able to:
1. Create documents, presentation slides and perform data manipulations using Libre Office packages for a given scenario.
2. Write, test and debug simple programs using expressions and statements in Python.
3. Develop programs with conditionals, loops, functions and packages using Python for a given problem.
4. Apply suitable data structure in Python for a real world problem.
5. Create and manipulate files using Python.

LIST OF EXPERIMENTS
1. Study of basic commands in Linux OS.
2. Creating document, presentation slides and performing mathematical calculations using Libre Office packages.
3. Solving problems using algorithm and flowchart.
4. Python statements to check variable validity, data types and expression evaluation.
5. Programs to implement decision control statements.
6. Programs to implement functions.
7. Programs to implement modules and packages.
8. Programs for string handling functions.
9. Programs to implement list, set, tuple and dictionary.
10. Programs for file handling.

SOFTWARE
- Python 3 interpreter for Linux environment
- Jupyter Notebook IDE
- Raptor Tool
- Libre Office Packages

TOTAL: 45 PERIODS

21MEL21 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C

0 0 3 1

PREAMBLE:

Computer Aided Drafting and Modeling Laboratory course provides the students with the knowledge on the use of software and its various features and tools for drafting and modeling the Engineering components with different geometries and morphological features, dimensioning, mentioning tolerances and for creating architectural drawings. This course includes drafting orthographic views of Engineering curves, simple solids and sectioned solids, 3D models of simple mechanical or electrical devices and drawing residential plans.

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

1. Develop the 2D sketches for the given conditions using drafting packages.
2. Sketch the orthographic views for the given isometric view of solids.
3. Create 3D models of simple engineering components.
4. Develop multiple views from the solid modeled.
5. Draw the plan and elevation of residential buildings.

LIST OF EXERCISES USING DRAFTING SOFTWARE (AUTOCAD OR EQUIVALENT)

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative and polar) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing a Title Block with necessary text and projection symbol.
3. Drawing curves – Ellipse, parabola, spiral, involute using B-spline or cubic spline.
4. Drawing front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views.
6. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model. (Eg. V-block, Base of a mixer, Simple stool, Objects with hole and curves).
7. Drawing isometric projection of simple objects.
8. Drawing a simple steel truss.
9. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
10. Drawing a plan of residential building (Two bed rooms, kitchen, hall, etc.)

TOTAL : 45 PERIODS

REFERENCES:

1. Gowri, S. and Jeyapoovan, T., "Computer Aided Drafting and Modeling Laboratory", Vikas Publishing House Pvt., Ltd., 1st Edition, 2011.
2. Manual prepared by the faculty of Mechanical Engineering Department, VCET.

e-RESOURCES:

1. http://www.pearsonhighered.com/educator/course/AutoCAD-ComputerAided-Drawing/91024782.page

21MCT02 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
2 0 0 0

PREAMBLE:

The study of biodiversity reflects the extent of the interest of a nation in its natural resources and heritage, which is considered as a crucial portion of the national wealth. Since India is one of the twelve mega-diversity center of the earth, much emphasis should be put on understanding, preserving and utilizing the biodiversity of our biotic resources. Environmental protection is an important issue for society today as scientific research provides evidence of increasing global warming, ozone depletion and higher levels of pollution. Engineers should learn how to design, develop and evaluate structures, equipment and systems to provide practical solutions to problems caused by pollution, exploitation of natural resources and population explosion.

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

1. Compare and contrast structure and function of forest and marine ecosystem to conserve biodiversity
2. Analyze the sources, effects, control measures of air and water, solid waste management to maintain green environment.
3. Describe overexploitation of forest, overutilization of water and environmental impacts related to food resources to preserve environment.
4. Explain human health, environment and disaster management through information technology.
5. Discuss air and water act to solve environmental issues of climatic change.

UNIT 1 ECOSYSTEM AND BIODIVERSITY MANAGEMENT ***6***

Importance of environmental studies-Ecosystem-Definition, Characteristics, structure and functions of Forest and Ocean ecosystem. Biodiversity-Definition, Significance, Values of biodiversity, Threats to biodiversity-Habitat loss and poaching, Biodiversity conservation-In-situ (Biosphere and National park), Ex-situ (Gene bank and Seed bank).

UNIT 2 ENVIRONMENTAL POLLUTION **6**

Pollution- Definition causes and effects of Air and Water. Control strategies-Air pollution- (Catalytic converter, Cyclone separator). Water pollution-waste water treatment (Primary, Secondary and Tertiary Treatment). Solid waste-Source and generation of solid waste, Methods of disposal- Sanitary land fill, Incineration and composting.

UNIT 3 NATURAL RESOURCES ***6***

Forest Resources: Functions of forest, deforestation-causes, consequences and steps to prevent deforestation.
Water Resources: Over-exploitation of surface and ground water, Benefits and problems of dams on forests and tribal people. Food Resources: Environmental impacts related to food resources –Effects of modern agriculture (fertilizer and pesticide problems), water logging and salinity.

UNIT 4 ROLE OF IT AND DISASTER MANAGEMENT ***6***

Role of IT in environment-Remote Sensing and GIS application, Global positioning system, Environmental data base. Role of IT in human health – EHR, Medical Transcription, Endoscopy, Automated dispensing machine (ADM), Teleconference, Picture achieving and Communication System (PACS) method. Disaster management-Cause, effects and mitigation of Flood, Cyclone, Earthquake, Tsunami

UNIT 5 SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATION ***6***

Social Issues: Climate change- Global warming, Ozone layer depletion, Water conservation-Rain water harvesting (Roof top method). Legislation- Function of State and Central pollution control Board (Air and Water).

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Dr.Arun Luiz T, 'Environmental Science and Engineering', 1st edition (2017), VK publications.
2. P. Yugananth & Dr. R. Kumaravelan, 'Environmental Science and Engineering', 2nd edition, reprint (2017),Scitech Publication (India) Pvt. Ltd., Chennai.

REFERENCES:

1. Benny Joseph, 'Environmental Science and Engineering', 3rd reprint (2015), McGraw Hill Education (India) Pvt Ltd.,New Delhi.
2. Gilbert M.Masters, 'Introduction to 'Environmental Engineering and Science', 2nd edition (2004), Prentice Hall of India Pvt. Ltd.

e-RESOURCES:

1. https://nptel.ac.in/courses/105104099/4 "Types and forms of Air Pollutants" – Prof. Mukesh Sharma, Department of Civil Engineering, IIT Kanpur.
2. https://nptel.ac.in/courses/105104213/8 "Introduction to natural hazards(Flood and Tsunami)" - Prof.Javed Malik, Department of Civil Engineering, IIT Kanpur.

21MAT31 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C

3 1 0 4

PREAMBLE:

The phenomena of heat conduction, wave and signal propagation in media are described by Partial Differential equations (PDE) or Difference equations. For analyzing such phenomena, knowledge of mathematical techniques for solving PDE and Difference equations are needed for engineering students. This course aims to provide sufficient knowledge to engineering students in the specific mathematical techniques such as Fourier series, Fourier transform, Z-transform and PDE.

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

1. Compute the trigonometric form of the Fourier series for periodic waveforms satisfying the Dirichlet's conditions and using them to evaluate infinite series.
2. Compute the solution for the standard forms of linear partial differential equations of first order and solve homogeneous partial differential equations of first and second order with constant coefficients.
3. Compute the analytical solution for the given physical model for the specified initial and boundary conditions in one dimensional and two dimensional distributions.
4. Compute the Fourier transform of elementary non-periodic waveforms using Fourier Transform properties.
5. Solve the difference equations of first and second order using Z-transform techniques.

UNIT 1 FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT 2 PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Singular Integrals – Solutions of standard types of first order partial differential equations: $F(p, q) = 0, F(z, p, q) = 0, F(x, p) = G(y, q)$ and $z = px + qy + F(p, q)$ – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT 3 APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

One dimensional wave equation – Transverse vibrations of a string – One dimensional equation of heat conduction – Steady state temperature distribution in a rod – Two dimensional steady state temperature distributions in a plate.

UNIT 4 FOURIER TRANSFORMS 9+3

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

UNIT 5 Z TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Inverse Z-transform (using Partial Fraction and Residues) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, University Press India (P) Ltd, Hyderabad (2015).
2. Grewal, B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publishers, Delhi (2016)

REFERENCES:

1. Ramana.B.V., "Higher Engineering Mathematics", First edition, Tata Mc-GrawHill Publishing Company limited, New Delhi, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth edition, Wiley Dream Tech India (P) Ltd. 2016
3. Babu Ram, "Engineering Mathematics", Second edition, Vol.2 , Dorling Kindersley India (P) Ltd, Licenses of Pearson Education in South Asia, 2012

e-RESOURCES:

1. http://nptel.ac.in/courses/111105035/27 , "Advanced Engineering Mathematics", Prof. Jitendra Kumar, Department of Mathematics, Indian Institute of Technology, Kharagpur
2. http://nptel.ac.in/courses/111106046, "Fourier Series", Prof.R.Radha, and Prof S. Thangavelu, Department of Mathematics, Indian Institute of Technology Madras, Chennai

21CET31 **CONSTRUCTION MATERIALS AND PRACTICES** **L T P C**
3 0 0 3

PREAMBLE:

The primary objective of the course is to familiarise with the basic building materials, properties and their applications.
This course aims to provide sufficient knowledge on the different types of masonries with their applications and various construction technologies involved in the sub structure and super structure construction.

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

1. Describe the basic construction materials.
2. Apply the various construction practices in the field.
3. Explain the construction of various formworks and scaffoldings.
4. Discuss the substructure construction practices.
5. Discuss the superstructure construction practices.

UNIT 1 CONSTRUCTION MATERIALS **9**

Stone as building material – Criteria for selection – Tests on stones – Dressing and quarrying of stone – Bricks: Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Lime: Preparation of lime mortar – Cement: Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time

UNIT 2 MASONRY **9**

Stone masonry – Classification – Materials used – Dressing of stones – Supervision of stone masonry – Brick masonry – Bond in brickwork – Supervision of brick masonry – Defects in brick masonry– Comparison of brick and stone masonry – Hollow block masonry – Load bearing wall – Partition wall – Cavity wall construction – Arches and Lintels – Flooring – Requirements of good floor - Types of flooring.

UNIT 3 CONSTRUCTION PRACTICES **9**

Form work - Types of Form work, types of materials used in form work – Scaffoldings - Types of Scaffoldings, Scaffolding Erection & dismantling, Scaffolding Inspection – Fire protection in structures - Classification of fire, general causes of fire, detection of fire and methods for fire control - Damp Proof Course - Causes of dampness, effects of dampness and methods of damp proofing - Type of joints in concrete - Construction, Expansion, Contraction and Isolation joints.

UNIT 4 SUB STRUCTURE CONSTRUCTION **9**

Box and 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.

UNIT 5 SUPER STRUCTURE CONSTRUCTION **9**

Launching girders, bridge decks, off shore platforms – Special forms for shells – Techniques for heavy decks – Material handling – Tall structures – Lightweight materials – Erection of light weight components – Support structure for heavy equipment and conveyors – Erection of articulated structures, braced domes and space decks.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Varghese, P.C. “Building Construction”, Prentice Hall of India Pvt. Ltd, New Delhi, 2016.
2. Bindra.S.P and Arora.S.P, “Building Construction”, Dhanpat Rai Publication Pvt, Ltd, 2010

REFERENCES:

1. V.N. Vazirani, and S.P. Chandola, “Engineering Materials”, Khanna Publishers, 2009.
2. M.S.Shetty, “Concrete Technology”, S.Chand Publishers, 2012.
3. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, “Building Construction”, Laxmi Publications Pvt. Ltd, 2008.

e-RESOURCES:

1. http://nptel.ac.in/courses/105102088/, “Building Materials and Construction”, Prof. Dr. B. Bhattacharjee, IIT Delhi.
2. http://nptel.ac.in/courses/105106053/, “Modern Construction Materials”, Prof. RavindraGettu, “IIT Madras.

21CET32 **SOLID MECHANICS** **L T P C**
3 0 0 3

PREAMBLE:
The primary objective of the course is to familiarise with the fundamental concepts of stress, strain and deformation of bars and beams. It deals with analyse of plane trusses, mechanism of load transfer in beams, the induced stress resultants and deformations.

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

1. Solve stress and strain relationship, thermal stress and strain for Mild and TOR steel.
2. Draw the shear force and bending moment diagram for statically determinate beams.
3. Calculate the deflection of beams by Double integration, Macaulay's, Moment area and Conjugate beam methods.
4. Analyse behavior of shafts subjected to torsion, closed, open and leaf springs.
5. Analyse plane trusses by using method of joints, sections and tension coefficient method.

UNIT 1 STRESS AND STRAIN **9**

Stress and Strain due to axial load - Elastic limit - Hooke's law - Stress and Strain relationship (Mild and TOR steel) - Stress and Strain in Composite sections - Thermal Stresses and Strains - Poisson's ratio - Relation between elastic constants (derivation) - Volumetric strain - Bulk Modulus - Basics of shear stress and shear strain.

UNIT 2 SHEAR FORCE AND BENDING MOMENT **9**

Introduction - Types of beams, load and reactions - Shear force and bending moment - Relationships between load, shear force and bending moment - Shear force and bending moment diagrams for statically determinate beams. Theory of simple bending - Analysis of beams for stresses.

UNIT 3 DEFLECTION **9**

Double integration method - Macaulay's method - Moment area method - Conjugate beam method for computation of slopes and deflections of determinate beams.

UNIT 4 TORSION OF SHAFTS AND SPRINGS **9**

Torsion of circular solid and hollow shafts - Elastic theory of torsion - Stresses and Deflection in circular solid and hollow shafts - combined bending moment and torsion of shafts - strain energy due to torsion - Power transmitted by the shaft - Shaft in series and parallel - Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel.

UNIT 5 TRUSSES **9**

Analysis of plane trusses - Method of joints - Method of sections - Method of tension coefficient.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Bansal.R.K., "Strength of Materials", Laxmi Publication, New Delhi, 2017.
2. Bhavikatti.S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.

REFERENCES:

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited, New Delhi, 2009.
2. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi, 2015.
3. Ramamrutham.S., " Strength of materials", DhanpatRai and Sons, Delhi, 2011.

e-RESOURCES:

1. http://nptel.ac.in/courses/105105108, "Strength of Materials", Prof. S.K. Bhattacharyya, IIT kharagpur.
2. http://nptel.ac.in/courses/112107147, "Strength of Materials", Dr. S. P. Harsha, IIT Roorkee.
3. http://nptel.ac.in/courses/112106141, "Strength of Materials", Prof. M.S. Sivakumar, IIT Madras.

21CET33 **FLUID MECHANICS** **L T P C**
3 0 0 3

PREAMBLE:

This course provides the fundamental knowledge on properties of fluids and characteristics of fluids in rest and motion. It deals with the pipe flow, pipe networks, boundary layers and advancement of practical applications and understanding the concept of model and prototype. It introduces dimensional analysis and develops knowledge in complexities involved in solving fluid flow problems.

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

1. Identify and explain the importance, application and inter-relationship of various properties of fluid.
2. Describe the behavior of fluids in motion with and without applying the forces.
3. Estimate the major and minor losses in pipe flow and calculate the flow through pipes connected in series and in parallels.
4. Classify the boundary layer thickness and explain layer separation and methods to control separation.
5. Analyse the dependent and independent parameters for a model of fluid flow.

UNIT 1 FLUID PROPERTIES AND FLUID STATICS **9**

Fluid - definition, distinction between solid and fluid - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, capillarity and surface tension - Fluid statics - Pressure at a point - Pascal's law - Hydrostatic law - absolute and gauge pressures - pressure measurements by manometers - centre of pressure - buoyancy - stability of floating body.

UNIT 2 FLUID KINEMATICS AND DYNAMICS **9**

Fluid Kinematics - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms) - Equation of streamline - stream function - velocity potential function. Fluid dynamics - equations of motion - Euler's equation along streamline - Bernoulli's equation - applications - Venturimeter, Orifice meter. Linear momentum equation and its application.

UNIT 3 FLOW THROUGH PIPES **9**

Flow through pipes - Loss of Energy in pipes - Major loss and minor loss - Hydraulic gradient and total energy line - Pipes in series and parallel - Pipe network.

UNIT 4 BOUNDARY LAYER **9**

Boundary layer - definition - boundary layer on a flat plate - thickness and classification - displacement, energy and momentum thickness - Boundary layer separation and control - drag in flat plate - drag and lift coefficients

UNIT 5 DIMENSIONAL ANALYSIS AND MODEL STUDIES **9**

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham's π-Theorem - Dimensionless parameters - Similitude and model studies - Distorted Models.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, New Delhi. 2015.
2. R.K. Bansal, "A textbook of Fluid mechanics and hydraulic machines", 9th Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.

REFERENCES:

1. Ramamrutham, S., "Hydraulic Fluid Mechanics and Fluid Machines", DhanpatRai and Sons, Delhi, 2014.
2. Streeter, V.L. and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 2010.
3. R. K Rajput, "A Text book of Fluid Mechanics and Hydraulic Machines", S. Chand Limited, 2016.

e-RESOURCES:

1. http://nptel.ac.in/courses/105103095, "Fluid Mechanics", Dr. N. Sahoo, IIT Guwahati.
2. https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2040, "Fluid Mechanics".
3. http://nptel.ac.in/courses/105101082, "Fluid Mechanics", Dr. T.I. Eldho, IIT Bombay.

21CET34 **SURVEYING AND GEOMATICS** **L T P C**
3 0 0 3

PREAMBLE:
Surveying is the process of determining by measurement, the relative positions of points on or near the earth surface. The data collected from a survey is used in the preparation of plans, maps, profiles, charts and diagrams. The course also emphasizes the importance of the modern surveying using total station and GPS.

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

1. Compute length, area, bearings and elevation of the given points.
2. Identify and explain the use of theodolite and tacheometry to find elevation of point.
3. Describe how the geodetic surveying is carried out in a large-scale survey.
4. Explain the working principle of total station and GPS.
5. Illustrate the setting out of simple curve in road alignment and application of remote sensing.

UNIT 1 CONVENTIONAL SURVEYING AND LEVELLING 9

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging. Compass - Types of Compass - Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing. Levelling- Principles and theory of Levelling – Temporary and Permanent Adjustments- Methods of Levelling- Booking – Reduction of Reduced level.

UNIT 2 THEODOLITE AND TACHEOMETRIC SURVEYING 9

Measurements of Horizontal and vertical angle - Temporary and permanent adjustments - Heights and distances. Tacheometer - Stadia Constants - Analytic Lens - Tangential and Stadia Tacheometry surveying. Contour – Characteristics of contours – Methods of contouring – Contour gradient – Uses of contour map.

UNIT 3 CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and vertical control – Methods – specifications – triangulation- baseline – satellite stations – reduction to centre. Trigonometrical levelling – single and reciprocal observations – traversing – Gale's table. Errors Sources - precautions and corrections – classification of errors – true and most probable values - weighed observations – principle of least squares - normal equation – method of correlates- adjustment of simple triangulation networks.

UNIT 4 MODERN SURVEYING 9

Total Station: Working principle - Parts and accessories - Fundamental quantities measured - On board calculations - Field procedure - Advantages - Errors and Good practices in using Total Station. GPS Surveying: Different segments - space, control and user segments - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Hand Held and Geodetic receivers - data processing - Traversing and triangulation.

UNIT 5 ADVANCED TOPICS IN SURVEYING 9

Curves: Definitions - Designation of a curve - Elements of simple curve - Location of tangent points - setting out of simple curve by offset and Rankine's methods. Hydrographic surveying – Tides - MSL - Sounding methods - Three-point problem. Remote sensing - basics, platform and sensors – Applications. Drones – LiDAR survey.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Kanetkar.T.P, and Kulkarni.S.V., "Surveying and Levelling", Vol. I & II, Pune VidyarthiGrihaPrakashan , 2006
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 10th Edition, 2017.

REFERENCES:

1. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7thEdition, McGraw Hill, 2001.
2. SatheeshGopi, R.Sathishkumar, N. Madhu, "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2008.
3. SatheeshGopi, "The Global Positioning System and Surveying using GPS", Tata McGraw, 2005

e-RESOURCES:

1. http://nptel.ac.in/courses/105107121/, "Surveying", Prof. J.K. Ghosh, IIT Roorkee.
2. http://nptel.ac.in/courses/105104101/, "Surveying", Prof.BharatLohani, IIT Kanpur.
3. https://nptel.ac.in/courses/105107158/, "Digital Land surveying and Mapping", Prof. J.K. Ghosh, IIT Roorkee.

21CEL31 **SOLID MECHANICS LABORATORY** **L T P C**
0 0 2 1

PREAMBLE:
The primary objective is to expose the students for the testing of different materials under the action of various forces and determination of their characteristics experimentally. It also enables the identification of hardness for the different types of metals.

Course Outcomes: Upon completion of the course, students will be able to:
1. Determine young's modulus, torsional strength and tensile strength of given specimens.
2. Determine the stiffness of open coiled and closed coiled springs.
3. Conduct the impact test of metal specimen.
4. Identify the hardness of metals.
5. Verify the Maxwell reciprocal theorem.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Compression test on wood.
3. Compression test on brick.
4. Double shear test on metal.
5. Torsion test on mild steel rod.
6. Impact test on metal specimen (Izod and Charpy).
7. Hardness test on metals (Rockwell and Brinell Hardness Tests).
8. Deflection test on metal beam.
9. Verification of Maxwell's reciprocal theorem.
10. Compression test on helical spring.

TOTAL = 30 PERIODS

21CEL32 **SURVEYING LABORATORY** **L T P C**
0 0 2 1

PREAMBLE:
The primary objective is to impart the knowledge on suitable surveying methods and instruments for a given problem. To familiarize the handling of a Dumpy level and theodolite and to train the students about the handling of Total Station.

Course Outcomes: Upon completion of the course, students will be able to:
1. Take accurate measurements, field booking, plotting and adjustment of errors.
2. Draw the longitudinal and cross section for the road works for the given area.
3. Determine the horizontal and vertical angles by reiteration and repetition method.
4. Determine the horizontal and vertical distances by tachometry.
5. Setting out the foundation and simple curve using chain, tape and theodolite.

LIST OF EXPERIMENTS

Chain Survey

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offsets
2. Setting out works – Foundation marking using tape for Single Room and Double Room

Compass Survey

3. Compass Traversing – Measuring Bearings & arriving included angles

Levelling - Study of levels and levelling staff

4. Fly levelling using Dumpy level

Theodolite - Study of Theodolite

5. Measurements of horizontal angles by reiteration and repetition and vertical angles
6. Determination of elevation of an object using single plane method when base is accessible / inaccessible.

Tacheometry

7. Heights and distances by Stadia Tacheometry
8. Heights and distances by Tangential Tacheometry

Total Station

9. Traverse using Total station

Setting out – Simple circular curve

10. Simple circular curve – Rankine's method

TOTAL = 30 PERIODS

21CEL33 **COMPUTER AIDED BUILDING DRAWING** **L T P C**
0 0 2 1

PREAMBLE:
The primary objective is to impart fundamental knowledge on AutoCAD or QCAD to make the students draw the plan, elevation and sectional view of a building and truss. To make the students to understand and learn various elements of Residential / Institutional / Workshop buildings and to develop its model.

Course Outcomes: Upon completion of the course, students will be able to:
1. Plan, orient and complete joinery details of paneled door.
2. Draw a building plan for the given area.
3. Prepare an elevation for the given plan.
4. Prepare a sectional view for the given plan.
5. Develop a 3 Dimensional model of a single storey single bay residential building.

LIST OF EXPERIMENTS

1. Principles of planning, orientation and complete joinery details of paneled door.

Draw the plan, elevation and cross section for the following given structures

2. Single storey residential buildings.
3. Multi storey residential buildings.
4. RCC framed structure.
5. Residential building with Madras terrace roof.
6. Buildings with sloping roof.
7. Industrial Building - North Light Roof Truss.
8. Develop a 3 Dimensional model of a single storey single bay residential building.

TOTAL = 30 PERIODS

21MCL03 ESSENTIAL ENGLISH FOR PROFESSIONALS L T P C
0 0 2 0

Preamble :

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Essential English for Professionals aims at enabling the learners to communicate effectively and appropriately in professional contexts by exposing them to situational LSRW tasks.

UNIT 1 LISTENING 6

Listening to Casual Conversation and TED Talks

UNIT 2 READING 8

Poem – Robert Frost – Road not Taken

Essays - Bacon's Essays

UNIT 3 WRITING 6

Letter Writing – Letters Seeking Permission and Letters Seeking Apology and Letters Requesting Certificates and Paragraph Writing

UNIT 4 PRESENTATION 7

Watching Presentations - Presentation Techniques - JAM and Three Minute Presentation

UNIT 5 VERBAL ABILITY 3

Verbal Analogy - Cloze Test- Idioms and Phrases- Sentence Completion – Concord – Common Errors

TOTAL : 30 PERIODS

REFERENCES:

1. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi,2018.
2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

e-RESOURCES:

1. https://agendaweb.org/listening/audio-books-mp3.html
2. https://www.ndtv.com/world-news
3. https://www.dw.com/en/tv/s-1452
4. https://www.naukri.com/blog/self-introduction-for-interview/
5. http://www.washington.edu/doit/TeamN/present_tips.html
6. https://nptel.ac.in/courses/pdf_link/109107121/lec52.pdf
7. http://learnenglishteens.britishcouncil.org/skills/reading
8. https://www.bbc.com/bitesize/guides/zphc9j6/revision/1
9. www.indiabix.com

21MAT43 **NUMERICAL METHODS** **L T P C**
3 1 0 4

PREAMBLE:

The primary objective of the course is to develop the basic understanding of numerical techniques. Numerical analysis is concerned with finding numerical solutions to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integral problems

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

1. Compute the real root of the algebraic and transcendental equations and solve the system of linear equations numerically.
2. Construct an Interpolation polynomial that approximates the given data table to determine the intermediate values.
3. Perform differentiation and integration for the functions using numerical techniques.
4. Compute the numerical solutions for the Initial value problems involving ordinary differential equations using single step and multi step methods.
5. Compute the numerical solution for the Boundary value problems involving partial differential equations using implicit and explicit methods.

UNIT 1 SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations -Newton Raphson method – Solution of linear system of equations- Gauss elimination –Pivoting- Gauss Jordon method - Iterative methods of Gauss Jacobi and Gauss-Seidel methods – Eigen value of a matrix by power method.

UNIT 2 INTERPOLATION AND APPROXIMATION 9+3

Interpolation with unequal intervals-Lagrangian's interpolation – Newton's divided difference interpolation –Interpolation with equal intervals -Newton's forward and backward difference formulas.

UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials –Numerical integration using Trapezoidal and Simpson's 1/3 rules – Evaluation of double integrals by Trapezoidal and Simpsons's 1/3 rules.

UNIT 4 INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Euler's methods-Modified Euler's method- Fourth order Runge – Kutta method for solving first order equations – Multistep methods- Milne's predictor and corrector methods for solving first order equations.

UNIT 5 BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9+3

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

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal. B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2014.
2. Gerald. C.F and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 7th Edition, New Delhi, 2013.

REFERENCES:

1. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGraw Hill Education India Private Limited,2016.
2. P.Kandasamy, K.Thilagavathy, K.Gunavathi, "Numerical methods", 3rd Edition, S.Chand and Company Pvt.Ltd, New Delhi, 2013.
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers" , Prentice Hall of India Private, 3rd Edition, New Delhi, 2011.

e-RESOURCES:

1. http://nptel.ac.in/courses/111105038/2, "Numerical Solution of Ordinary and Partial differential Equations", Prof. G. P. Raja Shekhar, Department of Mathematics, Indian Institute of Technology, Kharagpur
2. http://nptel.ac.in/courses/121102009/16, "Numerical Methods and Computation", Prof. S.R.K Iyengar , Department of Mathematics, Indian Institute of Technology ,New Delhi.

21CET41 **STRENGTH OF MATERIALS** **L T P C**
3 1 0 4

PREAMBLE:

The primary objective of the course is to impart knowledge on deflection of statically determinate beams, ideal columns and real columns. Strength of materials is concerned the estimation of load carrying capacity of columns, stresses due to unsymmetrical bending and analysis of members under two dimensional state of stress.

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

1. Compute deflection in beams using Castiglano's, Maxwell's and Virtual work methods.
2. Draw the shear force and bending moment diagram for indeterminate beams.
3. Solve the problems of short and long column subjected to axial, eccentric loads by using Eular's and Rankine Gordon formula.
4. Analyse plane members subjected to two dimensional state of stress.
5. Analyse beams subjected to unsymmetrical bending and curved bars using Winkler Bach formula.

UNIT 1 ENERGY PRINCIPLES **9+3**

Strain energy due to axial force, suddenly applied load and impact load - strain energy due to shear, flexure and torsion - Castigliano's theorems - Maxwell's reciprocal theorems - Principle of virtual work - application of energy theorems for computing deflections in beams.

UNIT 2 INDETERMINATE BEAMS **9+3**

Concept of analysis - Propped cantilever and fixed beams - fixed end moments, reactions and deflections - Theorem of three moments - analysis of continuous beams - shear force and bending moment diagrams.

UNIT 3 COLUMNS AND CYLINDER **9+3**

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 - Thin and Thick cylinders - Compound cylinders.

UNIT 4 STATE OF STRESS IN TWO DIMENSIONS **9+3**

2D State of stress - 2D normal and shear stress on any plane - Principal stresses and principal planes - Mohr's circle - Theories of failure basis.

UNIT 5 UNSYMMETRICAL BENDING OF BEAMS AND CURVED BEAMS **9+3**

Stresses due to unsymmetrical bending - Deflection of beam due to unsymmetrical bending - Shear Centre - Curved beams (Winkler Bach formula)**.**

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

TEXT BOOKS:

1. Bansal.R.K., "Strength of Materials", Laxmi Publication, New Delhi, 2017.
2. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand& company Ltd., New Delhi, 2010.

REFERENCES:

1. Egor P Popov, "Engineering Mechanics of Solids", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
3. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

e-RESOURCES:

1. http://nptel.ac.in/courses/112107146/, "Strength of Materials", Dr. Satish C Sharma, IIT Roorkee.
2. http://nptel.ac.in/courses/105101085/, "Structural Analysis I", Dr. R.S. Jangid, Dr. Siddhartha Ghosh, IIT Bombay.
3. http://nptel.ac.in/courses/112101095/,"Advanced Strength of Materials", Prof. S.K. Maiti, IIT Bombay.

21CET42 **HYDRAULIC ENGINEERING** **L T P C**

3 1 0 4

PREAMBLE:

This course deals with characteristics of open channel under uniform and non-uniform flow classifications and conditions. It provides basic knowledge in physical mechanisms of hydraulic jumps, surges and force exerted by the jet on vanes. It inculcates basic knowledge on the working principles and design of hydraulic machines.

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

1. Design most economical section for an open channel flow.
2. Describe the varied flow profiles under non-uniform flow.
3. Analyse and compute the force exerted by the jet on the vanes under stationary and moving conditions.
4. Design appropriate type and working proportions of turbines for the given conditions.
5. Identify and explain the type of pumps required for specific purpose.

UNIT 1 UNIFORM FLOW **9+3**

Definition and differences between pipe flow and open channel flow - Types of Flow - Discharge through open channel by Chezy's Formula - Empirical Formulae for Chezy's constant - Best hydraulic sections for uniform flow (Rectangular, Trapezoidal, Circular Section only) - Specific energy and specific energy curve - Critical depth and critical velocity.

UNIT 2 NON - UNIFORM FLOW **9+3**

Dynamic equations of gradually varied flow - Back water curve and Afflux - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Direct step method - Hydraulic jumps - Types - Surges.

UNIT 3 IMPACT OF JET ON VANES **9+3**

Force exerted by the jet - stationary and moving vertical plate, Inclined flat plate, curved plate - unsymmetrical moving curved plate - series of vanes - Jet propulsion.

UNIT 4 TURBINES **9+3**

Turbines - Classification - Pelton Wheel turbines - Francis turbine - Kaplan turbine - draft tube - Performance of turbine - Specific speed - Unit Quantities - Characteristic curves.

UNIT 5 PUMPS **9+3**

Centrifugal pumps - Minimum speed to start the pump - Multistage pumps - Cavitations in pumps - characteristics curve - Reciprocating pumps - Negative slip - Air vessels - Savings in work done - comparison between centrifugal pumps and reciprocating pumps – Submersible pump – working principle.

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

TEXT BOOKS:

1. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2009.
2. Bansal R K, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2017.

REFERENCES:

1. Subramanya K., "Flow in open channels", Tata McGraw Hill, New Delhi, 2008.
2. VenTe Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
3. R. K Rajput, "A Textbook of Fluid Mechanics and Hydraulic Machines", S. Chand Limited, 2016.

e-RESOURCES:

1. http://nptel.ac.in/courses/105107059, "Advanced Hydraulics", Dr. C. S. P. Ojha, IIT Roorkee.
2. http://nptel.ac.in/courses/105103021, "Advanced Hydraulics", Dr. Suresh A Kartha, IIT Guwahati.
3. https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2040, "Hydraulic Engineering", Dr.Venu Chandra, IIT Madras.

21CET43 **SOIL MECHANICS** **L T P C**
3 0 0 3

PREAMBLE:

Soil Mechanics is a discipline of Civil Engineering involving the study of soil, its behaviour and application as an engineering material. This course introduces the types of rock and engineering properties of the rock. It provides basic knowledge on the physical and engineering behavior and compaction characteristics of soils. This course focuses on the mechanism of stresses, consolidation, shear strength and stability analysis of slopes.

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

1. Discuss the physical geology and rock formation with engineering properties
2. Classify the soil for engineering purposes and compaction methods
3. Demonstrate the knowledge on flow of water, effective stress concepts, permeability and seepage of water below ground level.
4. Describe the vertical stresses due to external loads and consolidation theory.
5. Identify and explain the shear strength parameters and analyse the infinite and finite slopes.

UNIT 1 PHYSICAL GEOLOGY AND PETROLOGY 9

Structure of earth and its composition- weathering of rocks- landforms and process associated with river, wind, ground water and sea - Classification of rocks- Igneous, Sedimentary and Metamorphic rocks, distinction between three types of rocks and engineering properties -folds, faults and joints – relevance to Civil engineering - Earthquake and seismic zones in India.

UNIT 2 SOIL CLASSIFICATION AND COMPACTION 9

Nature of soil - Phase relationships - Index properties of soils – Atterberg's limits and indices – BIS and Unified soil classification system - Soil compaction – Theory of compaction, comparison of laboratory and field compaction methods - Factors influencing compaction behaviour of soils.

UNIT 3 SOIL WATER AND WATER FLOW 9

Soil water - Static pressure in water - Effective stress concepts in soils – Hydrostatic condition-Surcharge - Capillary action- Steady seepage condition – Quick sand condition - Permeability measurement in the laboratory, field pumping in and pumping out tests - Factors influencing permeability of soils - Introduction to flow nets.

UNIT 4 STRESS DISTRIBUTION AND SETTLEMENT 9

Stress distribution - Soil media - Boussinesq theory - Use of Newmark's influence chart - Components of settlement - Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory (Solutions not required) - Computation of rate of settlement. - $\sqrt{t}$ and log t methods- e-log p relationship - Factors influencing compression behaviour of soils.

UNIT 5 SHEAR STRENGTH AND SLOPE STABILITY 9

Shear strength of cohesive and cohesionless soils - Mohr - Coulomb failure theory - Measurement of shear strength - direct shear, triaxial compression, unconfined compression test and Vane shear tests - Liquefaction of soils.

Slope failure mechanisms - Types - Infinite slopes - Finite slopes - Method of Slices - Friction circle method - Fellenius method for Critical Slip Circle - Use of Taylor's stability number – landslides - Slope protection measures.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2005.
2. T N Ramamurthy, T G.Sitharam, "Geotechnical Engineering(Soil Mechanics)", S Chand & Co Ltd, New Delhi, 2005,

REFERENCES:

1. Murthy, V.N.S., "Geotechnical Engineering", S.Chand& Company Pvt. Ltd., New Delhi. 2011.
2. Punmia, B.C. "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 2005.
3. Das, B.M. "Principles of Geotechnical Engineering". Thompson Brooks / Coles Learning Singapore, 5th Edition, 2002.

IS CODE BOOKS:

IS:2720 – Part 1-17, Part 28-30, Part 36, Part 39-40

e-RESOURCES:

1. http://nptel.ac.in/courses/105103097, "Soil Mechanics", Prof. Baleshwar Singh, Civil Engineering, IIT Guwahati.
2. http://nptel.ac.in/courses/105101084, "Soil Mechanics", Dr. B.V.S. Viswanadham, Civil Engineering, IIT Bombay.
3. http://nptel.ac.in/syllabus/105104152, "Earth Sciences for Civil Engineering", Prof.JavedN.Malik, IIT Kanpur.

21CET44 HIGHWAY AND PAVEMENT ENGINEERING L T P C
3 0 0 3

PREAMBLE:

The course aims to make the students learn the principles of highways, their components and design of flexible and rigid pavements. Further, students will get acquainted with treatment for failures and remedial measures during maintenance of pavements.

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

1. Conduct surveys involved in planning of highway alignment.
2. Design cross section elements, sight distance, horizontal and vertical alignments.
3. Identify pavement materials based on characteristics and design flexible and rigid pavements as per IRC.
4. Discuss construction methodology based on the pavement type.
5. Develop drainage pattern and evaluate distresses in pavements and suggest remedial measures.

UNIT 1 HIGHWAY PLANNING AND ALIGNMENT 9

Significance of highway plans - Modal limitations towards sustainability - History of road development in India - Classification of highways- Locations and functions - Factors influencing highway alignment - Engineering surveys for alignment, objectives, conventional and modern methods.

UNIT 2 GEOMETRIC DESIGN OF HIGHWAYS 9

Typical cross sections of Urban and Rural roads - Cross sectional elements - Sight distances - Horizontal curves, Super elevation, transition curves, widening at curves - Vertical curves - Gradients - Lateral and vertical clearance at underpasses – Express ways.

UNIT 3 DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 9

Design principles - Pavement components and their role - Design of flexible pavement (IRC 37) - Design of rigid Pavements (Determination of stresses through IRC 58).

UNIT 4 HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE 9

Highway construction materials, properties, testing methods - CBR Test for subgrade - Tests on aggregate – Tests on bitumen - Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials- Glass, Fiber, Geosynthetics - Geo-Textiles, Geo-Membrane (problem not included) - Highway drainage - Construction machineries.

UNIT 5 EVALUATION AND MAINTENANCE OF PAVEMENTS 9

Pavement distress in flexible and rigid pavements - Pavement evaluation, Present Serviceability Index, skid resistance, structural evaluation, and evaluation by deflection measurements - Types of maintenance - Strengthening of pavements - Rigid and Flexible overlay.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.
3. Indian Road Congress (IRC), Guidelines and Special Publications of Planning and Design, 2005.

REFERENCES:

1. IRC standards 37-2012 (Guidelines for the design of flexible pavements) and IRC standards 58-2014 (Guidelines for the design of plain jointed rigid pavements).
2. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.
3. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010.
4. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia, 2012.

e-RESOURCES:

1. http://nptel.ac.in/courses/105101087/ Transportation Engineering I, Dr. Tom V Mathew, IIT Bombay.
2. https://books.google.co.in/books?isbn=9382609857/Dr. L.R. Kadiyali.

21CET45 PHYSIO - CHEMICAL PROCESS FOR WATER TREATMENT L T P C
3 0 0 3

PREAMBLE:

This course aims at imparting the knowledge on various stages of works involved in planning, designing and execution of protected water supply system to a town/city. Starting from demand estimation, identification of sources, studying the quality aspects of water at these sources, evolving a suitable treatment method to bring the quality to the permissible standards and finally, distribution of this treated water to the individual dwelling units are well addressed.

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

1. Estimate the population, analyze the water demand for a city and ascertain the water quality standards.
2. Design the conduits for transportation of water from the source to treatment plant and to the city.
3. Design an appropriate treatment system for the water available at the source.
4. Identify and explain suitable advanced water treatment methods.
5. Arrive the quantity of water for given city and to estimate the storage requirement of reservoir.

UNIT 1 PLANNING FOR WATER SUPPLY SYSTEM 9

Public water supply system - Planning - Objectives - Design period - Population forecasting - Water demand - Sources of water - Surface and Groundwater - Impounding reservoir - Development and selection of source - Water quality - Characterisation and BIS standards - Impact of climate change.

UNIT 2 CONVEYANCE SYSTEM 9

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

UNIT 3 WATER TREATMENT 9

Objectives - Unit operations and processes - Principles, functions design and drawing of Chemical feeding, flash mixers, flocculators, Sedimentation tanks - Slow sand and rapid sand filters - Disinfection - Residue management - Construction, operation and maintenance aspects of water treatment plants.

UNIT 4 ADVANCED WATER TREATMENT 9

Principles, functions and types of Aeration - Iron and manganese removal, Defluoridation - Nalgonda techniques - Prasanthi technology - Ion exchange adsorption method - Demineralization - Water softening - lime soda process - Zeolite process (Comparison only) - Design of Zeolite Softner - Desalination - Membrane Systems - Reverse Osmosis Process.

UNIT 5 WATER DISTRIBUTION AND SUPPLY TO BUILDINGS 9

Requirements of water distribution - Components - Service reservoirs - Functions and drawings - Network design - Computer applications - Analysis of distribution networks - Layout of distribution System - Leak detection methods - Components of house service connection.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Garg, S.K., "Environmental Engineering", Vol I, Khanna Publishers, New Delhi, 2014.
2. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. Birde G.S and Birde J.S., "Water Supply and Sanitary Engineering", Dhanpat Raj Publishing Co., New Delhi, 2015.
2. Modi, P.N., "Water Supply Engineering", Vol I, Standard Book House, New Delhi, 2010.
3. Manual on water supply and treatment, CPHEEO, Government of India, New Delhi, 2010.

e-RESOURCES:

1. http://nptel.ac.in/courses/105104102/ "Water and wastewater Engineering" Dr. P. Bose, IIT Kanpur.
2. http://nptel.ac.in/courses/105102159/ "Water Management", Dr. A.K. Gosain, IIT Delhi.

21CEL41 **HYDRAULIC ENGINEERING LABORATORY** **L T P C**
0 0 2 1

PREAMBLE:
This course provides an introduction to the properties and behavior of fluids. It enables to apply the concepts in civil engineering like the types of flow, flow losses in pipes, buoyancy principles and characteristics of the centrifugal pumps and turbines.

Objectives:
1. To familiarise the Bernoulli's principle by conducting the experiments.
2. To develop skills by analysing experimental data with theoretical values.
3. To demonstrate hydraulic principles used in engineering design with hands-on physical devices.

Course Outcomes: Upon completion of the course, students will be able to:
1. Determine flow rate sand co-efficient of discharge.
2. Measure and compute the major and minor losses in pipes.
3. Estimate the force exerted by jet of water on the flat plane.
4. Determine the characteristics of pump.
5. Select the type of turbine required with reference to available head of water and discharge.

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 orificemeter
5. Study of impact of jet on flat plate
6. Study of friction losses in pipes
7. Study of minor losses in pipes
8. Study on performance characteristics of centrifugal Pumps
9. Study on performance characteristics of reciprocating Pumps
10. Study on performance characteristics of impulse turbine
11. Study on performance characteristics of reaction turbine

TOTAL = 30 PERIODS

21CEL42 SOIL MECHANICS AND HIGHWAY ENGINEERING LABORATORY L T P C
0 0 2 1

PREAMBLE:
This course deals with the determination of various physical and engineering properties of soil. With the knowledge of these properties, students will able to identify, classify and appreciate the use of soil as a suitable construction material and design appropriate foundation for the structure. This course also imparts knowledge on testing of coarse aggregates thus enabling students to identify the coarse aggregates as an appropriate material for pavements

Course Outcomes: Upon completion of the course, students will be able to:
1. Determine engineering properties of soil.
2. Determine index, compaction and flow of water through soil media.
3. Determine the shear strength parameters.
4. Examine the quality of bitumen.
5. Determine the strength of subgrade soil.

LIST OF EXPERIMENTS

1. Specific gravity of soil solids (soil and coarse aggregates).
2. Grain size distribution - Sieve analysis (soil and coarse aggregates).
3. Atterberg limits.
4. Field density test (Sand replacement method and Core cutter method).
5. Determination of moisture - density relationship using Standard Proctor Compaction test.
6. Permeability determination (constant head and falling head methods).
7. Direct shear test on cohesion-less soil.
8. Unconfined compression test in cohesive soil.
9. Determination of binder content.
10. California Bearing Ratio.
11. Viscosity and softening point of bitumen.
12. Ductility and penetration resistance of bitumen.

TOTAL = 30 PERIODS

21CEL43 **SURVEY CAMP** **L T P C**

0 0 2 1

PREAMBLE:

To make the students acquainted with the field problems, a 6-day survey camp is arranged to execute the Road project, Block contouring project, Tachometric survey and Total Station Traversing at ideal locations.

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

1. Take accurate measurements, field booking, plotting and adjustment of errors.
2. Conduct topographic survey using total station.
3. Prepare contour map for the given area.
4. Determine the latitude and longitude of the given point using GPS.
5. Measure area of the plot using GPS traversing.

LIST OF EXPERIMENTS

1.Topographic survey using Total station

2. Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line

3. Block Level/ By squares of size at least 100 Meter x 100 Meter at least 20 Meter interval

4.Longitudinal and cross section - Road and canal alignment for a Length of not less than 1 Kilometer atleast L.S at Every 30M and C.S at every 90 M

5.Use of GPS to determine latitude and longitude and locate the survey camp location

6.Traversing using GPS

7. Foundation marking using Total station

TOTAL = 30 PERIODS

21MCL04 **PROFESSIONAL COMMUNICATION** **L T P C**
0 0 2 0

Preamble :
Communicative English is a life skill necessary for all students of Engineering and Technology. The course Professional Communication aims at enabling the learners to communicate effectively and appropriately in professional contexts by exposing them to situational LSRW tasks.

UNIT 1 **LISTENING** **6**

Listening to News Bulletins and Documentaries

UNIT 2 **GROUP DISCUSSION** **8**

Watching Group Discussion videos – Do's and Don'ts of GD – Mock GD

UNIT 3 **READING** **6**

Letters to Editor Column - Reading News Articles - Biographies of Famous Personalities

UNIT 4 **WRITING** **6**

IELTS Essay Writing

UNIT 5 **VERBAL ABILITY** **4**

Verbal analogy - Cloze Test- Idioms and Phrases- Sentence Completion -Error Spotting

TOTAL : 30 PERIODS

REFERENCES:

1. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi,2018.
2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

e-RESOURCES:

1. http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
2. https://www.bbc.com/bitesize/guides/zphc9j6/revision/1
3. https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers

21CET51 DESIGN OF REINFORCED CONCRETE ELEMENTS L T P C
3 0 0 3

PREAMBLE:
This course deals with design of basic structural elements viz. slab, beam, column and footing under limit state method and working stress method for singly, doubly and flanged beams deals with following with Indian standard code of practice.

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

1. Identify and explain the methods for the design of Reinforced concrete (RC) elements.
2. Design the beams by limit state method
3. Design the slabs under different support condition by limit state method.
4. Design the columns for axial and eccentric loadings by limit state method.
5. Design of footing by limit state method.

PREREQUISITE:21CET32 - SOLID MECHANICS
21CET41 - STRENGTH OF MATERIALS

UNIT 1 METHODS OF DESIGN OF CONCRETE STRUCTURES 9

Properties of Concrete and Reinforcing Steel - Type of Loads on Structures and Load combinations- Concept of Working Stress Method, Ultimate Load Design and Limit State Design Methods - Advantages of Limit State Method over other methods - Code of practices and Specifications - Analysis and Design of singly, doubly and Flanged beams by working stress method

UNIT 2 DESIGN OF BEAMS 9

Analysis and design of singly, doubly and Flanged beams – Use of design aids for Flexure - Behaviour of RC members in Shear, Bond and Anchorage - Design of RC members for combined Bending, Shear and Torsion- Design requirements as per current code.

UNIT 3 DESIGN OF SLABS 9

Analysis and design of one way and two way simply supported and continuous slabs -Two way slab- Design of simply supported and continuous slabs using IS code coefficient.

UNIT 4 DESIGN OF COLUMNS 9

Types of columns –Axially Loaded columns – Design of Rectangular, Square and circular short columns - Design for Uniaxial and Biaxially loaded Column using SP16 - Design of Slender columns.

UNIT 5 DESIGN OF FOOTING 9

Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular and sloped footings – Design of Combined Rectangular footing for two columns.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Varghese, P.C., “Limit State Design of Reinforced Concrete”, PHI, Pvt. Ltd., New Delhi, 2010.
2. Punmia. B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publication Pvt. Ltd., New Delhi, 2019.

REFERENCES:

1. UnnikrishnaPillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2011
2. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Krishnaraju.N.,“ Design of Reinforced Concrete Structures “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
4. Subramanian,N., ”Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2013.
5. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000.
6. SP16, IS456:1978 “Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999.

e-RESOURCES:

1. http://nptel.ac.in/courses/105105105/, “Design of Reinforced Concrete Structures”, Prof. NirjharDhang, IIT Kharagpur.
2. http://nptel.ac.in/105102088/ “Building materials and Construction”, Dr. B. Bhattacharjee, IIT Delhi.
3. http://www.iitk.ac.in/nicee/RP/2005_Design Philosphy_ICJ.pdf.

21CET52 **STRUCTURAL ANALYSIS - I** **L T P C**
3 1 0 4

PREAMBLE:
This course deals with the analysis of determinate, indeterminate beams and portal frames. It involves determination of moments including end moments and shear force, and constructing shear force, bending moment diagrams for the beams and frames.

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

1. Compute the member forces and deflection of determinate structures.
2. Analyse the continuous beams and frame by slope deflection method.
3. Analyse the continuous beams and frame by moment distribution method.
4. Compute the forces for continuous beams, frames and trusses using flexibility method.
5. Determine the displacement for continuous beams, frames and trusses using stiffness method.

PREREQUISITE:21CET32 - SOLID MECHANICS
21CET41 - STRENGTH OF MATERIALS

UNIT 1 DEFLECTION OF DETERMINATE STRUCTURES 9+3

Determination of Static and Kinematic Indeterminacy in Beams, plane and space Trusses and Frames. Deflection of statically determinate beams, pin jointed trusses and rigid jointed frames by energy and unit load method. Analysis of rigid jointed indeterminate frames by consistent deformation method.

UNIT 2 SLOPE DEFLECTION METHOD 9+3

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams with and without sinking of supports - Analysis of single storey portal frames with and without sway.

UNIT 3 MOMENT DISTRIBUTION METHOD 9+3

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous beams with and without sinking of supports - Analysis of single storey portal frames with and without sway.

UNIT 4 FLEXIBLITY MATRIX METHOD 9+3

Equilibrium and compatibility - Determinate and Indeterminate structures – Degree of Indeterminacy - Primary structure - Compatibility conditions - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

UNIT 5 STIFFNESS MATRIX METHOD 9+3

Element and global stiffness matrices - Analysis of continuous beams - Coordinate transformations - Rotation matrix - Transformations of stiffness matrices, load and displacements vectors - Analysis of pin jointed plane and rigid frames with redundancy restricted to two.

TOTAL =60 PERIODS

TEXT BOOKS:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis", Vol. 1 & Vol. 2, Laxmi Publications Pvt. Ltd, New Delhi, 2016.
2. Bhavaikatti, S.S, "Structural Analysis", Vol. 1& Vol. 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. DevadasMenon, "Structural Analysis", Narosa Publishing House, 2014.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", 13th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
3. Pandit G.S and Gupta S.P., "Structural Analysis – A Matrix Approach" Tata McGraw-Hill Publishing Ltd. New Delhi, 2008

e-RESOURCES:

1. http://nptel.ac.in/courses/105101085/, "Structural Analysis I", Dr. R.S. Jangid, Dr. Siddhartha Ghosh, IIT Bombay.
2. http://nptel.ac.in/courses/105106050/, "Advanced Structural Analysis", Prof. DevdasMenon, IIT Madras.
3. http://nptel.ac.in/courses/10510519/, "Structural Analysis II", Prof. L.S. Ramachandra, Prof. SudhirkumarBarai, IIT Kharagpur.

21CET53 **FOUNDATION ENGINEERING** **L T P C**
3 0 0 3

PREAMBLE:

This course deals with the investigation of soil condition and to select the suitable type of foundation. It provides knowledge on the design of shallow, deep foundation and earth retaining walls.

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

1. Identify and explain the methods of soil investigation and report preparation.
2. Analyse the shallow foundation considering shear failure and settlement criteria.
3. Design footings and rafts.
4. Explain the load carrying capacity and settlement of pile foundation.
5. Design retaining structures.

PREREQUISITE:21CET43 – SOIL MECHANICS

UNIT 1 SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Methods of exploration - auger, wash boring and rotary drilling - Depth of boring - Spacing of bore hole - Sampling techniques - Disturbed and undisturbed sampling methods - Split spoon, Thin wall, Stationery and piston sampler - Penetration tests (SPT and SCPT) and plate load test - Bore log report - Data interpretation.

UNIT 2 SHALLOW FOUNDATION 9

Location and depth of foundation - Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi's and BIS formula - Factors affecting bearing capacity - problems - Bearing capacity from in-situ 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 - Methods of minimizing total and differential settlements.

UNIT 3 FOOTINGS AND RAFTS 9

Types of footings - Contact pressure distribution - design of Isolated footing - Types of loading and proportioning – design of Combined footings, Raft foundation and eccentric footings.

UNIT 4 PILE FOUNDATION 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 Hileys) - Capacity from in-situ tests (SPT and SCPT) - Negative skin friction - Uplift capacity- Group capacity – efficiency of pile groups(Feld's rule, Converse - Labarra formula) - Settlement of pile groups .

UNIT 5 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 - Rebhanns and Culmann Graphical method - Pressure on the wall due to line load.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2005.
2. GopalRanjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International Pvt. Ltd, New Delhi, 2005.

REFERENCES:

1. Punmia, B.C. "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 2005.
2. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, 2007.
3. IS 6403: 1981 (Reaffirmed 1997) "Bearing capacity of shallow foundation", BIS, New Delhi, 1998.
4. IS:2192:1979,"Code of practice for "Subsurface Investigations for foundations", BIS,New Delhi,1979
5. IS 8009 (Part2):1980 (Reaffirmed 1995) "Deep foundations subjected to symmetrical static vertical loading", BIS, New Delhi, 1992.
6. IS 2911 (Part1):1979 (Reaffirmed 1997) "Concrete Piles" BIS, New Delhi, 1994.
7. IS 2911 (Part 4):1979 (Reaffirmed 1997) "Load Test on Piles", BIS, New Delhi, 1997.

e-RESOURCES:

1. http://nptel.ac.in/courses/105107120, "Foundation Engineering", Prof. Mahendra Singh, Prof. Priti Maheswari, Prof. N.K. Samadhiya, IIT Roorkee.
2. http://nptel.ac.in/courses/105101083, "Foundation Engineering", Dr. DeepankarChoudhury, IIT Bombay.

21CEL51 **CONCRETE TECHNOLOGY LABORATORY** **L T P C**
0 0 2 1

PREAMBLE:
This laboratory course involves experiments on physical test on cement, aggregate, fresh concrete and hardened concrete.
COURSE OUTCOMES: Upon completion of the course, students will be able to:
1. Determine the physical properties and strength of cement.
2. Determine the properties of Fine aggregates.
3. Determine the properties of coarse aggregates.
4. Determine the properties of fresh concrete.
5. Determine the properties of hardened concrete.

PREREQUISITE:21CET31- CONSTRUCTION MATERIALS AND PRACTICES

LIST OF EXPERIMENTS

1.PHYSICAL TESTS ON CEMENT:

i. Specific Gravity.
ii. Consistency.
iii. Initial and Final setting time.
iv. Soundness.
v. Compressive strength of cement.

2.TESTS ON AGGREGATE:

i. Gradation of Aggregates.
ii. Specific gravity and Water absorption.
iii. Bulking of Sand and bulk density.
iv. Abrasion Test.
v. Crushing strength and impact test.

3.TESTS ON FRESH CONCRETE:

i. Slump cone.
ii. Flow table.
iii. Compaction factor.
iv. Vee Bee.

4.TESTS ON HARDENED CONCRETE:

i. Compressive strength.
ii. Tensile Strength.
iii. Flexural strength.
iv. Modulus of Elasticity

TOTAL = 30 PERIODS

PREAMBLE:
The objective of this laboratory course is to obtain characteristics of potable water and wastewater.
COURSE OUTCOMES: Upon completion of the course, students will be able to:
1. Determine the physical and chemical impurities present in the water.
2. Determine the amount of oxygen required for self-purification of a stream.
3. Estimate the amount of coagulant required for water treatment.
4. Determine the degree of treatment required for water and wastewater treatment.
5. Determine the type of chlorination required for water treatment.

PREREQUISITE:21CET45 - PHYSIO-CHEMICAL PROCESS FOR WATER TREATMENT

LIST OF EXPERIMENTS

1. Determination of (i) pH (ii) Turbidity.
2. Determination of hardness.
3. Estimation of acidity and alkalinity.
4. Determination of solids.
5. Determination of residual chlorides.
6. Determination of dissolved oxygen.
7. Determination of Available chlorine in bleaching powder.
8. Determination of chemical oxygen demand.
9. Determination of (i) Nitrate (ii) Phosphate (iii) Ammonium nitrogen
10. Determination of Sulphates.
11. Biochemical oxygen demand (Demonstration).

TOTAL = 30 PERIODS

21MCL09 COMMUNICATION SKILLS LABORATORY **L T P C**
0 0 2 0

PREAMBLE:

Communication Skill is a life skill necessary for all students of Engineering and Technology. The course Communicative Skills Laboratory aims at developing effective oral and written communication to facilitate their success in competitive examinations, and recruitment screening thereby ensuring professional success and progress.

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

1. Respond quickly and correctly to questions from different types of scripts , exhibiting good comprehension and analyzing skills
2. Participate effectively in formal group discussions and prepare professional e mails , persuasive and expository paragraphs to establish and meet organizational needs and goals.
3. Fare well in IELTS and other English language assessment segments of competitive examinations within the stipulated time.
4. Write effective resumes and face interviews with communicative competence and confidence, with a good knowledge of career skills .
5. Select appropriate vocabulary and idiomatic expressions , identify errors in syntax , arrange sentences to make meaningful paragraphs, without any aid.

UNIT 1 RECEPTIVE SKILLS **6**

LISTENING & READING – Developing Listening & Reading Skills - Comprehension and Analysis –Listening & Reading for Main Idea - Specific Information - Sequence-Vocabulary - Cultural Interest-Attitude and Opinion- Functional language.

UNIT 2 PRODUCTIVE SKILLS **8**

SPEAKING - Group Discussion skills – Structure- Types- Techniques - Keywords -Vital qualities -Tips to improve performance. **WRITING -** Emails and Paragraph Writing - Expository and Persuasive

UNIT 3 ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS **4**

Orientation to International English Language Testing System (IELTS), Public Service Commission Exams (TNPSC,UPSC)

UNIT 4 CAREER SKILLS **6**

Different types of Interview formats - Answering Questions – FAQ's - Mock Interviews - Body Language - Preparation of Résumé and Job Application Letter - Team Work - Managing Time - Managing Stress - Negotiation Skills - Networking Professionally - Social Protocols – Upskilling

UNIT 5 VERBAL ABILITY **6**

Synonyms and Antonyms - Verbal Analogy - Cloze Test- Idioms and Phrases - Sentence Completion - Jumbled Sentences - Error Spotting - Theme Detection - Sentence Arrangement

TOTAL : 30 PERIODS

RECOMMENDED SOFTWARE: Globerena

REFERENCES:

1. Rizvi M.Ashraf 'Effective Technical Communication' MC Graw Hill Education, New Delhi,2005.
2. Koneru Aruna 'Professional Communication' MC Graw Hill Education ,Chennai, 2008.
3. Upadhyay Meenakshi & Arun Sharma 'Comprehension Interpersonal & Communication Skills for General Studies Civil Services Preliminary Examination' MC Graw Hill Education, New Delhi,2012.

WEB SOURCES:

1. http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
2. https://www.teachingenglish.org.uk/article/email-writing
3. https://www.naukri.com/blog/frequently-asked-hr-interview-questions-and-answers/
4. http://www.oxforddictionaries.com/words/writing-job-applications
5. https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers

21MCT05 **APTITUDE AND LOGICAL REASONING**
(Common to all BE/B.Tech Programmes)

L	T	P	C
2	0	0	0

PREAMBLE:

Aptitude tests are used to determine an individual's ability/potential to succeed in a certain task, with no prior knowledge or training and are frequently used as part of a pre-employment assessment. Aptitude tests are a proven tool used to identify those who are best equipped to carry out any given role.

A **logical reasoning** test is a form of testing that is widely used by corporate employers to help assess candidates during their recruitment process.

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

1. Solve the given equation using appropriate simplification methods.
2. Apply aptitude method of ratio and proportion to solve the given scenario.
3. Calculate time, speed, distance by applying suitable aptitude method for the given problem statement.
4. Calculate percentage and profit & loss for the given problem statement.
5. Compute simple interest, compound interest and predict relationship for the given problem/scenario.

UNIT 1 **6**

Number System, Simple Equation, Sequence and Series

UNIT 2 **6**

Ratio and Proportion, Problems on Ages, Partnership

UNIT 3 **6**

Time and Distance, Problems on Trains, Boats and Streams

UNIT 4 **6**

Percentage, Profit and Loss, Directions Sense

UNIT 5 **6**

Simple Interest and Compound Interest, Blood Relations

TOTAL : 30 PERIODS

REFERENCES:

1 Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017

2 Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S.Chand Publications, 2021

21CET61 DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY STRUCTURES L T P C
3 0 0 3

PREAMBLE:
This course deals with the concept of design and detailing of earth and water retaining structures, analysis and design of Masonry structures.

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

1. Design cantilever and counterfort retaining walls.
2. Design of underground and surface water Retaining Structures.
3. Design the special structures viz. flat slab and staircase.
4. Identify and explain the yield line pattern for slabs.
5. Design of masonry walls and columns.

PREREQUISITE:21CET51 - DESIGN OF REINFORCED CONCRETE ELEMENTS
21CET52 - STRUCTURAL ANALYSIS - I

UNIT 1 RETAINING WALL 9

Design of Cantilever and Counterfort retaining walls - Horizontal Backfill with Surcharge - Design and Drawing.

UNIT 2 LIQUID STORAGE STRUCTURES 9

Design of RCC Water Tanks - On ground Circular and rectangular, underground Rectangular Tanks - Design of circular flat and domed roof slab - Design and Drawing. Design procedure for Over Head Water tank (Concept Only).

UNIT 3 SPECIAL STRUCTURES 9

Design of staircases- Ordinary, Dog Legged and staircase with stringer beams - Design of flat slabs - column strip - middle strip - with and without column drop - Design and Drawing.

UNIT 4 YIELD LINE THEORY 9

Yield line theory for slabs of square, rectangular and circular shapes with different boundary conditions subjected to UDL by virtual work method - corner lever effects – lower bound solution introduction to Hiller Borg's strip method

UNIT 5 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 Masonry walls and columns with axially and eccentrically load.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Varghese, P.C., " Advanced Reinforced Concrete Design", Prentice Hall of India, Pvt. Ltd., New Delhi, 2012.
2. Subramanian,N., "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2013.
3. Dayaratnam P," Bricks and Reinforced Brick Structures", Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi, 1997.

REFERENCES:

1. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2009
2. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Krishnaraju.N.," Design of Reinforced Concrete Structures", CBS Publishers & Distributors Pvt. Ltd., New Delhi.
4. B.C.Punmia, Ashok Kumar Jain and Arun kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publications (P) Ltd., New Delhi, 2007.
5. Krishnamurthy D., "Structural Design and Drawing Vol I, II and III", CBS Publishers, 2010.
6. IS 456(2000) Indian Standard Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi.
7. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999.
8. SP34 Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.
9. IS 3370 Part 1 to 4 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice–General Requirements, Code of Practice, Bureau of Indian Standards, New Delhi.
10. IS 1905 -1985 Indian Standard Code of practice For Structural Use Of Unreinforced Masonry, Bureau of Indian Standards, New Delhi.

e-RESOURCES:

1. http://nptel.ac.in/courses/105105105/, "Design of Reinforced Concrete Structures", Prof. NirjharDhang, IIT Kharagpur.
2. http://nptel.ac.in/105102088/ "Building materials and Construction", Dr. B. Bhattacharjee, IIT Delhi.
3. http://www.iitk.ac.in/nicee/RP/2005_Design Philosphy_ICJ.pdf.

21CET62 **STRUCTURAL ANALYSIS - II** **L T P C**
3 1 0 4

PREAMBLE:
This course aims at determination of effect of moving loads and draw the influence line. This course involves the analysis of indeterminate structures using the concept of plastic analysis and to evaluate the analysis under concentrated, uniformly distributed load for arches, cables and suspension bridges.

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

1. Plot the ILD for Simply supported and over hanging beams subjected to moving load.
2. Explain Muller Breslau principle and draw the influence lines for statically indeterminate beams.
3. Analyze indeterminate beams and rigid frames.
4. Identify the vertical reaction, horizontal thrust and bending moment for two and three hinged arches.
5. Analyze the internal forces in the Cables and Suspension bridges.

PREREQUISITE:21CET52 - STRUCTURAL ANALYSIS - I

UNIT 1 INFLUENCE LINES FOR DETERMINATE BEAMS 9+3

Construction of Influence Line Diagram (ILD) for shear force and bending moment - Calculation of critical stress resultants due to concentrated and distributed moving loads for simply supported and overhanging beams - absolute maximum bending moment.

UNIT 2 INFLUENCE LINES FOR INDETERMINATE BEAMS 9+3

Muller Breslau's principle– Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one).

UNIT 3 PLASTIC ANALYSIS 9+3

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 rigid frames.

UNIT 4 ARCHES AND CABLES 9+3

Arches - Types of arches – Analysis of three hinged and two hinged arches - Parabolic and circular arches – Settlement and temperature effects. Components and their Functions - Analysis of cable under concentrated loads and UDL - Shape of cable under self-weight

UNIT 5 SUSPENSION BRIDGES AND INTRODUCTION TO FEM 9+3

Bending Moment and Shear Force in suspension bridges with three hinged stiffened girders. Basic concept of finite element method-steps involved in finite element analysis-Discretisation-Advantages and disadvantages of finite element analysis (FEM)..

TOTAL = 60 PERIODS

TEXT BOOKS:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis", Vol. 1 & Vol. 2, Laxmi Publications Pvt. Ltd, New Delhi, 2016.
2. Bhavaikatti, S.S, "Structural Analysis", Vol. 1& Vol. 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. DevadasMenon, "Structural Analysis", Narosa Publishing House, 2014.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", 12th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
3. Pandit G.S and Gupta S.P., "Structural Analysis – A Matrix Approach" Tata McGraw-Hill Publishing Ltd. New Delhi, 2008.
4. Dr.S.Senthil., ―Finite Element Analysis‖ Lakshmi publications, Chennai.

e-RESOURCES:

1. http://nptel.ac.in/courses/105101085/, "Structural Analysis I", Dr. R.S. Jangid, Dr. Siddhartha Ghosh, IIT Bombay.
2. http://nptel.ac.in/courses/105106050/, "Advanced Structural Analysis", Prof. DevdasMenon, IIT Madras.
3. http://nptel.ac.in/courses/10510519/, "Structural Analysis II", Prof. L.S. Ramachandra, Prof. SudhirkumarBarai, IIT Kharagpur.

21CET63 **DESIGN OF STEEL STRUCTURES** **L T P C**
3 1 0 4

PREAMBLE:
To introduce limit state design of structural steel members subjected to tensile, compressive and transverse loads. This course deals with design of structural steel elements such as tension members, columns, beams, plate girders, purlin including its connection and design procedure of gantry girder.

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

1. Design of structural steel connections.
2. Design of tension members.
3. Design of compression members.
4. Design of structural steel beam and plate girder.
5. Design of industrial building components and gantry girder.

PREREQUISITE: 21CET32 - SOLID MECHANICS
21CET41 - STRENGTH OF MATERIALS
21CET52 - STRUCTURAL ANALYSIS - I

UNIT 1 CONNECTIONS **9+3**

Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Basics of riveted connection – Connections using bolting, welding – Design of bolted and welded joints – Eccentric connections – Efficiency of joints.

UNIT 2 TENSION MEMBERS **9+3**

Types of tension members and sections Mode of failure – Net area – Net effective sections for plates and angles in tension – Concept of shear lag – Design of plate and angle tension members – Connections in tension members – Use of lug angles – Design of tension splice.

UNIT 3 COMPRESSION MEMBERS **9+3**

Types of compression members and sections – Mode of failure – Effective length – Slenderness ratio – Design of axially loaded single and compound section compression members – Design of built up laced and battened type columns – Design of slab base and Gusseted base for axially loaded columns.

UNIT 4 BEAMS **9+3**

Design of laterally supported and unsupported beams – Built up beams – Beams subjected to uniaxial and biaxial bending – Design of welded plate girders – Intermediate and bearing stiffeners – Flange and web splices.

UNIT 5 ROOF TRUSSES AND INDUSTRIAL STRUCTURES **9+3**

Roof trusses – Roof and side coverings – Purlin in roof trusses – Design of channel and I section Purlins. Design procedure of gantry girder.

TOTAL = 60 PERIODS

TEXT BOOKS:

1. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
2. S K Duggal., "Limit State design of steel Structures", Mc.Graw Hill Education (India) Private Limited, New Delhi, 2010.

REFERENCES:

1. Jayagopal L S and Tensing.D, "Design of steel structures", 1st edition, Vikas Publishing House private Ltd., 2016.
2. Bhavikatti.S.S, "Design of Steel Structures" By Limit State Method as per IS:800–2007, IK International Publishing House Pvt. Ltd., 2009
3. Shiyekar. M.R., "Limit State Design in Structural Steel", PHI Learning Private Limited, Delhi, 2nd Edition, 2013.
4. IS 800:2007, General Construction in Steel-Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.
5. IS 875:2015, Design Loads (Other than Earthquake) for Buildings and Structures, Code of Practice, Bureau of Indian Standards, New Delhi

6 IS 875:1987 (Part 1), Code of practice for design loads (other than earthquake) for buildings and structures (Second revision), Bureau of Indian Standards, New Delhi, 1987.

7 IS 875:1987 (Part 2), Code of practice for design loads (other than earthquake) for buildings and structures (Second revision), Bureau of Indian Standards, New Delhi, 1987

e-RESOURCES:

1. http://www.nptel.ac.in/courses/105106112/ "Design of steel structures", Prof. S.R.Satish Kumar and Prof. A.R.Santha Kumar, Indian Institute of Technology, Madras.
2. http://www.steel-insdag.org/TM_Contents.asp "Prof. Rangachari Narayanan, Retired Head of the Education and Publications Division, The Steel Construction Institute, England", Institute for Steel Development & Growth, Kolkata.

21CEL61	ENVIRONMENTAL AND IRRIGATION ENGINEERING – DESIGN AND DRAWING	L T P C 0 0 2 1

PREAMBLE:
The objective of this laboratory course is to design and drawing with a suitable scale of public health and irrigation structures.
COURSE OUTCOMES: Upon completion of the course, students will be able to:
1. Design and draw the components of rapid sand filter.
2. Design and draw the settling and flocculation tank.
3. Design and draw the primary and secondary treatment of sewage plant.
4. Design and draw the various canal structures.
5. Design and draw the components of septic tank.

PREREQUISITE: 21CET45 - PHYSIO-CHEMICAL PROCESS FOR WATER TREATMENT

LIST OF EXPERIMENTS
Design and Drawing of

1. Flow diagram - Water and wastewater.
2. Screen and Grit chamber.
3. Rapid sand filter.
4. Clariflocculator.
5. Septic tank.
6. Activated sludge process.
7. Direct Sluice - Tower head and Wing wall types.
8. Aqueduct.
9. Surplus weir.

TOTAL = 30 PERIODS

21MCT07 **ARITHMETIC AND ANALYTICAL ABILITY**
(Common to all BE/B.Tech Programmes)

L	T	P	C
2	0	0	0

PREAMBLE:

Arithmetic And Analytical Ability evaluates the talent and potential to perform a certain task, with no prior knowledge and/or training. This course deals with sort of problems on dynamic thinking, numeric capacity and spatial question. This course is further used for prediction of future success both in educational and vocational careers and aptitude skills help the students in the proper choice of courses and careers.

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

1. Compute time, work, capacity and identify the pattern by analyzing the given problem/scenario
2. Analyze the given problem involving mixture, averages, seating arrangement and apply the suitable method to get the appropriate result.
3. Interpret the given chart and determine the solution.
4. Identify and apply the appropriate permutation, Combination, probability technique to determine the solution.
5. Infer the solution for the given scenario involving syllogisms, clocks, calendar using suitable techniques.

UNIT 1 **6**

Time and Work, Pipes and Cisterns, Symbol Series

UNIT 2 **6**

Alligation or Mixture, Averages, Seating Arrangements

UNIT 3 **6**

Data Interpretation-Table Charts, Bar Charts, Pie Charts, Line Charts

UNIT 4 **6**

Permutation and Combination, Probability

UNIT 5 **6**

Syllogisms, Clocks, Calendar

TOTAL : 30 PERIODS

REFERENCES:

1. Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017
2. Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S.Chand Publications, 2021

21CET71 **ENGINEERING ECONOMICS AND COST ANALYSIS** **L T P C**
3 0 0 3

PREAMBLE:

The main objective of this course is to make the student know the basic law of economics, how to organise a business, the financial aspects related to business, different methods of appraisal of projects and pricing techniques.

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

1. Explain the basics on economics, its characteristics and classification.
2. Discuss the demand and supply schedule.
3. Summarize the different forms of business and its banking.
4. Explain the financing, its types and flow of funds.
5. Describe the costing types and breakeven analysis.

PREREQUISITE:NIL

UNIT 1 BASIC ECONOMICS **9**

Definition of economics - nature and scope of economic science - nature and scope of managerial economics - basic terms and concepts - goods, utility, value, wealth - factors of production, land, its peculiarities - labour - economies of large and small scale - consumption -wants - its characteristics and classification - law of diminishing marginal utility – relation between economic decision and technical decision.

UNIT 2 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 3 ORGANISATION **9**

Forms of business, proprietorship, partnership, joint stock company, cooperative organization, state enterprise - mixed economy - money and banking - banking - kinds - commercial banks -central banking functions - control of credit - monetary policy - credit instrument.

UNIT 4 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 5 COST AND BREAK EVEN ANALYSES **9**

Types of costing, traditional costing , 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 – breakeven chart – managerial uses of break even analysis.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Dewett K.K. &Varma J.D., “Elementary Economic Theory”, S Chand & Co., 2006
2. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002.
3. Samuelson P.A., “Economics - An Introductory Analysis”, McGraw-Hill, 2019.

e-RESOURCES:

1. https://nptel.ac.in/courses/112107209/ Engineering Economic Analysis, Dr. Pradeep K. Jha, IIT Roorkee.
2. https://nptel.ac.in/courses/105103023/Construction Economics & Finance, Dr. BuluPradhan, IIT Guwahati.

21CET72 **ESTIMATION AND QUANTITY SURVEYING** **L T P C**
3 0 0 3

PREAMBLE:
To acquire knowledge in estimation of different building components, rate analysis, tender practices, contract procedures, valuation of land & building and preparation of reports.

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

1. Estimate of the building elements.
2. Prepare abstract bill of quantities.
3. Execute rate analysis for the materials and labour.
4. Discuss the types of contracts.
5. Carry out valuation of land and buildings

PREREQUISITE:21CET51- DESIGN OF REINFORCED CONCRETE ELEMENTS
21CET61 - DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY STRUCTURES
21CET63- DESIGN OF STEEL STRUCTURES

UNIT 1 ESTIMATION OF BUILDINGS **9**

Types of estimates - Units of measurements - Methods of estimates - Load bearing and framed structures - Calculation of quantities of earthwork, brick work, RCC, PCC, plastering, white washing, and painting / varnishing for doors and windows, residential building with flat roof – commercial buildings

UNIT 2 ESTIMATION OF MISCELLANEOUS STRUCTURES **9**

Types of arches - Calculation of brick work and RCC works in arches - septic tank with soak pit– Road estimating - bituminous and cement concrete roads - retaining wall – culverts - Steel requirement and bar bending schedule – R.C.C roof slab, beam, column and foundation, staircase - G.I sheet roof over steel truss.

UNIT 3 RATE ANALYSIS, SPECIFICATIONS AND TENDERS **9**

Standard data – Observed data – Schedule of rates – Standard data for man hours and machineries – Rate analysis - Specifications - Sources - Preparation of detailed and general specifications - Tenders - Tamil Nadu Transparency in Tenders act 2000 - Tender notices - types - Tender procedures - Drafting model tenders, E-tendering - Digital signature certificates.

UNIT 4 CONTRACTS **9**

Contract - Types, formation and 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 5 VALUATION AND REPORT **9**

Definitions - types and methods of valuation - Necessity - Capitalised value - Depreciation - Escalation - Valuation of land and Buildings - Calculation of Standard rent - Mortgage – Lease - Principles for report preparation - Report on estimate of residential building and roads.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003.
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand& Company Ltd., 2004.

REFERENCES:

1. Kanagasabapathy B., "Practical Valuation Engineering", 1st Edition, Volume. I, II & III, K. Ehilaalarasi Kanagasabapathy Publications, 2006.
2. Hand Book of Consolidated Data – 8/2000, Vol.1, PWD Tamil Nadu.
3. Schedule of Rates - PWD, Government of Tamilnadu, Chennai.
4. Tamil Nadu Transparencies in Tenders Act, 2000.
5. Arbitration and Conciliation Act, 1996

e-RESOURCES:

1. http://nptel.ac.in/courses/105103093/14, "Estimation and Rate Analysis", Prof. Arbind Kumar Singh, Civil Engineering, IIT Guwahati.
2. http://nptel.ac.in/courses/105103023/35, "Cost Estimating", Dr. BuluPradhan, Civil Engineering, IIT Guwahati.

21CEL71 COMPUTER AIDED DESIGN AND DRAFTING LABORATORY L T P C
0 0 2 1

PREAMBLE:
This course enhances knowledge about how to analyze and design the various components of the different types of the structure using STADD Pro. software

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

1. Design and Draw structural detailing of Reinforced cement concrete (RCC) retaining wall.
2. Design and Draw structural detailing of RCC buildings.
3. Design and Draw structural detailing of T beam bridge.
4. Design and Draw structural detailing of RCC water tank.
5. Design and Draw structural detailing of steel structures.

PREREQUISITE:21CET61 - DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY STRUCTURES

LIST OF EXPERIMENTS

1. 2D analysis and design of continuous beam with various loading
2. 2D analysis of single and multi-storied frame
3. Analysis and design of single storey RCC building
4. Analysis, design and detailing of multi-storey RCC building elements
5. Analysis, design and detailing of isolated and rectangular combined footing.
6. Lateral load (wind) analysis of high-raised buildings
7. Analysis and design of RCC rectangular elevated water tank
8. Analysis of plane truss
9. Analysis of steel chimney
10. Analysis and design of a structural steel building.

TOTAL = 30 PERIODS

21CEL72 **DESIGN PROJECT** **L T P C**
0 0 2 1

PREAMBLE:

This course imparts the knowledge and improves the design capability of the student. It is used to carry out a thematic design project in one of the specialisation of Civil Engineering

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

1. Prepare the plan of a civil engineering structure.
2. Identify appropriate techniques to analyze civil engineering structures.
3. Design the structure as per bureau of Indian standards.
4. Prepare the detailed drawings for structural elements.
5. Prepare the consolidated project report for tender or any other purpose.

PREREQUISITE:NIL

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1. Assessment marks : 20 marks
   (Decided by conducting 3 reviews)
2. Evaluation of Project report : 30 marks
3. Viva voce examination : 50 marks
   (Evaluated by the examiner appointed by the HOD)

NOTE:

This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC & Steel structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection, Design of bridges (ROB and RUB) and water tank etc. The design problem can be allotted to either an individual student or a group of students comprising of not more than four. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

21CEL73	IN-PLANT TRAINING	L T P C 0 0 2 1

PREAMBLE:

This course provides industrial exposure in Civil Engineering related organisations. It train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. It helps students to develop skills in facing and solving the field problems.

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

1. Identify the real world civil Engineering related problems.
2. Apply the theoretical concepts studied in the class rooms practically.

PREREQUISITE:NIL

EVALUATION PROCEDURE

Students have to undergo four-week practical training before the commencement of seventh semester in Civil Engineering related organisations of their choice but with the approval of the department for the entire course. At the end of the training student will submit a report as per the prescribed format to the department. The student shall make a power point presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. This course is mandatory and a student has to pass the course to become eligible for the award of degree.

21MCT08 INDIAN CONSTITUTION AND TRADITIONAL KNOWLEDGE L T P C
2 0 0 0

PREAMBLE: The course provides basic information on Indian Constitution and Indian Traditional knowledge. This is essential for all citizens and especially for engineers so that they become aware of Indian polity and governance. This also reminds the citizen about their obligation, adherence and up keeping of Constitutional rights.

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

1. Outline the evolution of Indian constitution and Federal structure
2. List and explain the functions of Centre, States and District Administrations
3. Elaborate the roles of Panchayat raj
4. Explain the powers and roles of Election Commission
5. Illustrate the Indian traditional knowledge and elucidate their recovery

UNIT 1 **6**

'Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy - Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT 2 **6**

Governor: Role and Position, CM and Council of ministers, State Secretariat: organisation, Structure and Functions District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

UNIT 3 **6**

Panchayatraj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role, Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT 4 **6**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

UNIT 5 **6**

Basic structure of Indian Knowledge System-Modern Science and Indian Knowledge –Philosophical Tradition - Indian Linguistic Tradition (Phonology, morphology, syntax and semantics) – Indian Artistic Tradition

TOTAL: 30 PERIODS

TEXT BOOKS:

1. M.Rajaram, Indian Constitution, New Age International, 2009
2. V. Sivaramakrishnan (Ed.) Cultural Heritage of India (Course Material),Bharatiya Vidya Bhavan, Mumbai. 5th Edition,2014

21HST12 **HUMAN VALUES AND PROFESSIONAL ETHICS** **L T P C**
(Common to All Programmes) **3 0 0 3**

PREAMBLE:
Universal Human Values is a life skill necessary for all students of Engineering and Technology. The course aims to identify the values and skills, and to realize the need, basic guidelines, content and process of value education. Professional Ethics For Engineers deals with the human values, integrity and work ethics in the common world. This course is mainly concerned about the theories of ethics, which form the basis for the understanding and responsibility of the various groups encountered in Engineering

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

1. Relate the significance of value inputs in a classroom and start applying them in their life and profession.
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual.
3. Interpret the value of harmonious relationships based on the trust and respect in their life and profession.
4. Discuss the ethical issues related to Engineering.
5. Discuss Engineer's work in the context of its impact on society.

UNIT 1 Introduction to Universal Human Values 9

Understanding the need, basic guidelines, content and process for Value Education. Self Exploration–Mechanism for self exploration. Continuous Happiness and Prosperity- Basic Human Aspirations and its requirements for fulfillment of Human Aspirations understanding and living in harmony at various levels.

UNIT 2 HARMONY IN ONESELF, FAMILY AND SOCIETY 9

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationships. Trust and Respect- values of relationship. Difference between intention and competence. Difference between respect and differentiation

UNIT 3 HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics. Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models.

UNIT 4 ENGINEERING ETHICS 9

Senses of Engineering Ethics– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy – Kohlberg's theory – Gilligan's theory – Consensus and controversy – Models of professional roles –Professional responsibility - Moral reasoning - Theories about right action – Self interest – Self respect – Duty ethics – Customs and religion.

UNIT 5 ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation – Engineers as responsible experimenters – Role of codes- Codes of Ethics – Sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE) – A balanced outlook on law - Safe exits -The Bhopal gas tragedy and Challenger case study.

TOTAL : 45 PERIODS

Text Books:

1. Gaur R R, Sangal R, Bagaria G P, "A Foundation Course in Human Values and Professional Ethics". 2009.
2. Govindarajan M, Natarajan S and Senthil Kumar V. S, "Engineering Ethics", PHI Learning Pvt. Ltd, New Delhi, 2017

REFERENCES:

1. Banerjee B P, "Foundations of Ethics and Management", Excel Books. 2005.
2. Bajpai B L, "Indian Ethos and Modern Management", New Royal Book Co., Lucknow. Reprinted 2008.
3. Subramanian R, "Professional Ethics", Oxford university press, 2017.

e-RESOURCES:

1. https://www.uhv.org.in/
2. https://nptel.ac.in/courses/109/106/109106117/

21CEL81 **PROJECT WORK** **L T P C**
0 0 2 1

PREAMBLE:
This course deals with the thematic project in one of the specialisation of Civil Engineering. It develops the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. It helps the students in preparing project reports and to face reviews and viva voce examination.

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

1. Review and evaluate the available literature on the chosen problem.
2. Formulate the methodology to solve the identified problem.
3. Apply the principles, tools and techniques to solve the problem.
4. Use advanced software techniques / skills.
5. Prepare Technical reports.

PREREQUISITE:NIL

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1. Internal Marks : 20 marks
   (Decided by conducting 3 reviews)
2. Evaluation of Project Report : 30 marks
3. Viva voce examination : 50 marks
   (Evaluated by the examiner appointed by the HOD)

NOTE:

This project work is to enable the students to work in convenient groups of not more than four in a group on the project involving theoretical and experimental studies related to Civil Engineering. Every project work shall have the faculty members of Civil Engineering to act as a supervisor. The hours allotted for this course shall be utilised by the students to receive directions from the supervisor, on library reading, laboratory work, computer analysis or field work and also to present in periodical reviews the progress made in the project. The students also permitted to carry out their project in the neighboring industry under the guidance of faculty members of Civil Engineering.

Each student shall finally produce a project work report covering background information, literature study, problem statement, materials and methodology, experiments conducted, results and discussions with references. This experience of project work shall help the student in expanding his / her knowledge and provide opportunity to utilise the creative high order thinking and inference capability.

21CEE11 **IRRIGATION ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

To expose the different phases in irrigation planning, practices, storage structures, diversion structures, distribution canal system and irrigation management

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

1. Assess the water requirement of crops
2. Explain the methods and types of irrigation
3. Summarize the types of Impounding structures
4. Design the canal systems
5. Execute irrigation system management

UNIT 1 CROP WATER REQUIREMENT **9**

Need - Classification of irrigation - Merits and demerits of irrigation - types of crops –crop season - Duty, delta and base period - Consumptive use of crops - Estimation of evapotranspiration using experimental and theoretical methods

UNIT 2 IRRIGATION METHODS **9**

Tank irrigation - Well irrigation - Irrigation methods: Surface and Sub-Surface and Micro Irrigation - Design of drip and sprinkler irrigation - Ridge and furrow irrigation - Irrigation scheduling - Water distribution system - Irrigation efficiencies

UNIT 3 DIVERSION AND IMPOUNDING STRUCTURES **9**

Types of Impounding structures - Gravity dam - Forces on a dams - Design - Earth dams, Arch dams - Diversion Head works - Weirs and Barrages.

UNIT 4 CANAL IRRIGATION **9**

Canal regulations - Direct sluice - Canal drop - Cross drainage works-Canal outlets - Design of prismatic canal -canal alignments - Canal lining - Kennedy‘s and Lacey‘s Regime theory - Design of unlined canal.

UNIT 5 WATER MANAGEMENT IN IRRIGATION **9**

Modernization techniques - Rehabilitation - Optimization of water use - Minimizing water losses - On form development works - Participatory irrigation management - Water resources associations - Changing paradigms in water management - Performance evaluation - Economic aspects of irrigation.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Santosh Kumar Garg, ― Irrigation Engineering and Hydraulics Structures‖, Khanna Publications Pvt.Ltd, New Delhi, 2009.
2. Dr. B. C. Punmia, ―Irrigation and Water Power Engineering‖, Lakshmi Publications, 2010.

REFERENCES:

1. Linsley R.K. and Franzini J.B, ―Water Resources Engineering‖, McGraw-Hill Inc, 2000
2. R. K. Sharma and T. K. Sharma, ―Irrigation Engineering‖, S. Chand & Co, 2006
3. Dilip Kumar Majumdar, ―Irrigation Water Management‖, Prentice-Hall of India, New Delhi, 2008.

e-RESOURCES:

1. https://nptel.ac.in/courses/126105010, “Irrigation and Drainage”, Prof. Damodhara Rao Mailapalli, Department of Agriculture and Food Engineering, IIT Khargarpur.
2. http://nptel.ac.in/downloads/105105110/, “Water Resources Engineering”, Dr.Dhrubajyoti Sen, IIT Kharagpur.

21CEE12 **HYDROLOGY**

L	T	P	C
3	0	0	3

PREAMBLE:

The objective of this course elaborates to apply basic understanding of hydrologic cycle due to intensity of rainfall, infiltration, flood routing and basic concepts and assessment of groundwater flows.

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

1. Explain the hydrologic cycle and precipitation measurement in terms of rainfall, intensity and duration frequency.
2. Identify and explain the infiltration and evaporation process.
3. Discuss the types of hydrograph and amount of flow through graphical method.
4. Discuss the different methods of flood routing and forecasting and warning.
5. Discuss the groundwater hydrology and different flow laws.

UNIT 1 PRECIPITATION MEASUREMENT 9

Hydrologic cycle - Types of precipitation - Forms of precipitation - Measurement of Rainfall - Rain gauge density - Spatial and temporal measurement methods - Frequency analysis of point rainfall - Intensity, duration, frequency relationship - Probable maximum precipitation.

UNIT 2 INFILTARTION 9

Losses from precipitation - Evaporation process - Reservoir evaporation - Infiltration process - Infiltration capacity - Measurement of infiltration - Infiltration indices - Isochrones - Factors affecting runoff - Estimation of runoff – Effective rainfall.

UNIT 3 HYDROGRAPHS 9

Components of hydrograph- Factors affecting hydrograph -Base flow separation - Unit hydrograph - Derivation of unit hydrograph - S curve hydrograph - Unit hydrograph of different deviations - Synthetic unit hydrograph - application of unit hydrograph.

UNIT 4 FLOOD ROUTING 9

Flood frequency studies - Recurrence interval - Gumbel‘s method - Flood routing – Reservoir flood routing - Muskingum‘s channel routing - Flood control - Flood control economics- Flood forecasting and warning.

UNIT 5 GROUND WATER HYDROLOGY 9

Types of aquifers - Darcy‘s law - Dupuit‘s assumptions - Confined aquifer - Unconfined aquifer - Recuperation test - Transmissibility - Specific capacity - Pumping test - Steady flow analysis only - pollution in relation to water use.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. R.C.Ward and M.Robinson, ― Principles of Hydrology, Tata McGraw Hill, New Delhi, 2013.
2. H.M. Raghunath, ―Hydrology, 2nd Edition, New Age International (P) Limited, 2015.

REFERENCES:

1. Jayaramy Reddy. P., ―Hydrology‖, Tata McGraw-Hill Publications Pvt.Ltd, New Delhi, 2016.
2. Todd, D.K., and Mays, L. W., ―Groundwater Hydrology‖, John Wiley & Sons, Singapore, 2015.
3. K Subramanya, ―Engineering Hydrology‖, Tata McGraw Hill, New Delhi, 2015.

e-RESOURCES:

1. http://nptel.ac.in/downloads/105101002/ ―Advanced Hydrology‖, Dr. Subhankar Karmakar , IIT Bombay.
2. http://www.civilenggforall.com/2015/09/hydrology-for-water-management-by-stephen-thompson-free-download-pdf-civilenggforall.com.html.
3. http://ocw.unesco-ihe.org/mod/folder/view.php?id=511, ―Advanced hydrology and Hydraulics‖, Dr P.J.M. de Laat, Prof. Dr H.H.G. Savenije.

21CEE13 **WATER RESOURCES SYSTEMS ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the knowledge of water resources and national water policy of India and to familiarise the irrigation management practices of the past, present and future.

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

1. Gain knowledge about fundamentals of hydrology and precipitation types and characteristics.
2. Analyze infiltration process, evaporation process and Calculate runoff using various measurements.
3. Analyze different components of hydrograph, derivation of various types of hydrograph using base hydrograph and formulate various models
4. Estimate flood using various approaches, flood frequency analysis and methods and analyze flood routing.
5. Determine the hydrologic modeling and watershed modeling.

UNIT 1 STATISTICS AND PROBABILITY IN HYDROLOGY 9

Probability and probability distributions – basic concepts, Properties of random variables 'Some discrete distribution and applications in earth sciences, Normal distribution and other continuous distributions, Parameter estimation theory and methods, Time series analysis.

UNIT 2 HYDROGRAPH THEORY 9

Components of hydrograph, base flow separation, direct runoff hydrograph, Unit hydrograph theory, derivation of unit hydrograph, S-hydrograph and instantaneous unit hydrograph, Derivation of unit hydrograph for ungauged catchments, conceptual models - Time Area Diagram, Clark model, Nash model, Dooge models, synthetic unit hydrograph and its derivation

UNIT 3 FLOOD ESTIMATION 9

Peak discharge estimation procedures, deterministic and probabilistic approaches, enveloping curve, rational method, SCS and unit hydrograph methods, Design flood, return period, flood frequency analysis, probabilistic and statistical concepts, and time series analysis, Gumbel's and log Pearson Type III methods.

UNIT 4 FLOOD ROUTING 9

Concepts of flow routing, hydraulic and hydrologic routing, Reservoir routing, Channel routing, Muskingum and Muskingum-Cunge methods of channel routing and flood forecasting.

UNIT 5 MODELLING APPROACHES IN HYDROLOGY 9

Hydrological Model: Mathematical models and types, watershed models and types. PRMS (Precipitation Runoff Modeling System) model, Hydrologic Modeling System (HEC-HMS), MODFLOW, ARIMA.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Chow, V.T, Maidment, D.R., and Mays, L.W., Applied Hydrology, Tata McGraw Hill, 2010
2. McCuen, R.H., Hydrologic Analysis and Design, Prentice Hall Inc. N York, 2005

REFERENCES:

1. Patra, K.C, Hydrology and Water Resources Engineering, Narosa Publications, 2008
2. Singh, V.P. "Hydrologic Systems,", Prentice Hall Inc., NYork
3. Viessman, W., Lewis, G.L. and Knapp, J.W. "Introduction to Hydrology", Harper & Row Publications, 2015

e-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105201/
2. https://archive.nptel.ac.in/courses/105/105/105105110/

21CEE14 **GROUND WATER ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

The objective of this course is to understanding the principles of groundwater governing equations, techniques and characteristics of different aquifers for the development and management of groundwater.

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

1. Explain the importance of artificial recharge and groundwater quality concepts.
2. Discuss the design and practical problems of groundwater aquifer.
3. Discuss the unsteady flow equation by various methods and obtain the solutions.
4. Identify the salinity problems to improve the groundwater quality.
5. Explain the basics of groundwater and hydraulics of sub surface flows.

UNIT 1 HYDROGEOLOGICAL PARAMETERS 9

Introduction - Water bearing properties of rock - Type of aquifers - Aquifer properties - permeability, specific yield, transmissivity and storage coefficient - Methods of estimation - Ground water table fluctuation and its interpretations - Groundwater development and potential in India - GEC norms.

UNIT 2 GROUNDWATER HYDRAULICS 9

Objectives of groundwater hydraulics - Darcy‘s Law - Groundwater equation - Steady state flow - Dupuit Forchheimer assumption - Unsteady state flow - Theis and Jacob method - Slug tests - Image well theory - Partial penetrations of wells.

UNIT 3 GROUNDWATER MANAGEMENT 9

Need for management model - Database for groundwater management - Groundwater balance study - Introduction to mathematical model - Conjunctive use - Collecting well and Infiltration gallery.

UNIT 4 GROUNDWATER QUALITY 9

Ground water chemistry - Origin, movement and quality - Water quality standards - Health and aesthetic aspects of water quality - Methods of saline intrusion - Environmental concern and regulatory requirements.

UNIT 5 GROUNDWATER CONSERVATION 9

Artificial recharge techniques - Remediation of saline intrusion - Groundwater management studies - Protection zone delineation, Contamination source inventory, remediation schemes - Ground water pollution and legislation.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Todd D K., Ground Water Hydrology, John Wiley and Sons, 2nd Edition 2007.
2. Raghunath H M., Ground Water Hydrology, New Age International (P) Limited, New Delhi, 2014.

REFERENCES:

1. Fitts R Charles., Groundwater Science, Elsevier, Academic Press, 2002.
2. Ramakrishnan S., Ground Water, K.J. Graph arts, Chennai, 1998.

e-RESOURCES:

1. http://nptel.ac.in/courses/105105042/16, Groundwater Hydrology,Dr. Anirban Dhar Dr. V.R. Desai ,IIT Kharagpur.
2. http://nptel.ac.in/courses/105101002, Advanced Hydrology- Dr. Ashu Jain ,IIT Kanpur.

21CEE15 WATERSHED CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

PREAMBLE:

To provide the technical and sociological understanding of a watershed. To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits.

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

1. Recognize and Interpret the morphological features of a watershed.
2. State, design and sketch the soil conservation structures.
3. Describe the micro catchment and apply the concepts to design the small water harvesting Structures.
4. Illustrate the application of modern tools and technology in the management of watershed.
5. Classify the management activities and to develop an integrated watershed development plan.

UNIT 1 WATERSHED CONCEPTS 9

Watershed - Definition, need and elements - Principles - Influencing factors: Geology - Soil - Morphological characteristics - Toposheet - Delineation - Codification - Prioritization - Watershed atlas.

UNIT 2 SOIL CONSERVATION MEASURES 9

Types of erosion – Water and wind erosion: Causes, factors, effects and management – Soil conservation measures: Agronomical and mechanical - Design of terraces and bunds - Estimation of soil loss – USLE equation - Sedimentation.

UNIT 3 WATER HARVESTING AND CONSERVATION 9

Yield from a Catchment - Traditional water harvesting techniques - Micro - Catchments - Design of small water harvesting structures: Farm Ponds, Percolation Tanks, Check dams, Grassed Waterways.

UNIT 4 GIS FOR WATERSHED MANAGEMENT 9

Applications of remote sensing and Geographical information system - Role of decision support system - Conceptual models and Case studies.

UNIT 5 WATERSHED MANAGEMENT 9

Project proposal formulation - Watershed development plan - Entry point activities – Watershed economics - Agroforestry - Grassland management - Wasteland management – Watershed approach in government programmes - People's participation - Evaluation of watershed management programmes - Integrated watershed management - Case studies.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Ghanashyam Das, Hydrology and Soil Conservation Engineering, Prentice Hall of India Private Limited, New Delhi, Second Edition, 2009.
2. Suresh, R. Soil and Water Conservation Engineering, Standard Publishers and Distributors Private Limited, New Delhi, 2020.

REFERENCES:

1. Glenn O Schwab. etal, Soil and Water Conservation engineering, Wiley India Private Limited, 2009.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, Second Edition 2009.

e-RESOURCES:

1. https://nptel.ac.in/courses/105101010 - Watershed Management,Dr.T.I.Eldho,IIT Bombay
2. http://ecoursesonline.iasri.res.in/course/view.php?id=542 - Watershed Planning and Management, Dr. V. R. Desai and Dr.A.Mishra ,IIT Kharagpur.

21CEE16 **WATER QUALITY AND MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

To understand the fundamentals of mathematical models and their importance in water quality modeling and to impart the skills to use water quality modeling software for surface and groundwater quality modeling.

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

1. Know about the principles of water quality modelling.
2. Understand the pollutant transport phenomena in surface and groundwater.
3. Apply the knowledge of surface water quality modelling to predict the water quality of rivers, Lakes and estuary.
4. Predict the groundwater contamination transport.
5. Predict water quality of surface and sub surface water using numerical solution.

UNIT 1 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 2 POLLUTION TRANSPORT **9**

Transport phenomena - Advection, diffusion, dispersion - Contamination transport in surface and subsurface water - Simple transport models - Steady state and time variable solutions – Conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport.

UNIT 3 SURFACE WATER QUALITY MODELLING **9**

Water quality modeling of streams, lakes and estuaries - Water quality - Model sensitivity - assessing model performance; Models for dissolved oxygen, pathogens and COD, BOD – Streeter Phelp's model for point and distributed sources - Modified streeter Phelp's equations.

UNIT 4 GROUND WATER QUALITY MODELLING **9**

Groundwater flow and mass transport of solutes - Groundwater quality modelling using numerical methods - Parameters, Input - output stresses, Initial and Boundary conditions - Degradation of organic compounds in subsurface - Model calibration : steady state and unsteady state – Sensitivity Analysis - Model validation - Seawater intrusion - Basic concepts and modeling.

UNIT 5 WATER QUALITY MANAGEMENT MODELS **9**

Exposure to surface water and groundwater quality modeling software's - MIKE 21, WASP, QUAL2E and MODFLOW - Demonstration - Case studies - Modeling multilayer groundwater flow system - Artificial recharge feasibility through modeling - Groundwater contamination, restoration and management.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Steven C. Chapra, "Surface Water Quality Modelling", Tata McGraw-Hill Companies, Inc., New Delhi2018.
2. "Water Quality Modelling for Rivers and Streams" Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands2017.

REFERENCES:

1. Ne-Zheng Sun, Alexander Sun ,"Mathematical Modelling of Groundwater Pollution", Springer New York, 2012
2. Jacob Bear, A. H.-D. Cheng,"Modelling Groundwater Flow and Contaminant Transport , Springer Science & Business Media, 2010.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ce12/preview - "Water and Wastewater Treatment" ,Prof.Bhanu Prakash Vellanki,IIT Roorkee.
2. https://nptel.ac.in/courses/105104102 - "Raw Water Source and Quality",Dr.P.Bose, IIT Kanpur.

21CEE17 **URBAN WATER INFRASTRUCTURE**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart knowledge and skills relevant to water management in the context of urbanization

And relate engineering principles to water supply, storm water and wastewater management, along with related regulations and best management practices from around the world.

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

1. Explain various functional elements of urban ecosystem.
2. Calculate urban runoff, compute supply and demand of water, draw hydrograph.
3. Compare advantages of newer techniques of green infrastructure and illustrate benefits.
4. Assess the operation and maintenance needs of urban water systems.
5. Propose best management practices for Indian context.

PREREQUISITE:

UNIT 1 URBAN ECOSYSTEM **9**

Cities as Ecological system - Hybrid ecosystem - Resilience in urban ecosystem – Human components of Ecosystem - Urban pattern and ecosystem function - Population and community dynamics, functions of urban ecosystem.

UNIT 2 URBAN HYDROLOGY **9**

Urban hydrological cycle - Function - Human induced changes in urban watershed - Hydrological calculation - Runoff - Infiltration - hydrograph.

UNIT 3 URBAN STORM WATER MANAGEMENT **9**

Design of drainage system - Roadway drainage analysis - Types of inlet - inlet design – Design of storm drain - Storm water management regulations - Structural storm management systems - Newer trends in storm water management (Green infrastructure) - Installation - Operation and Maintenance.

UNIT 4 WATER CONSERVATION AND REUSE **9**

Trends in supply and demand - indoor conservation - Outdoor conservation - Water reuse - Rainwater harvesting - Public education.

UNIT 5 WATER GOVERNANCE **9**

Challenges in water sector - Institutional setting, Supply management, Demand management, Waste water management - Private sector participation, urban service delivery, customer satisfaction, financial resource management - Case studies of best practices in cities across the world.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. AnandChiplunkar, K Seetharam and CheonKheong (ed) (2012), "Good Practices in urban water management" ADB, National University Singapore.
2. Mohammad Karamouz, Ali Moridi, Sara Nazif (2010), Urban Water Engineering and Management, 1st Edition, CRC Press

REFERENCES:

1. HormozPazwash (2016), "Urban storm water management", CRC Press
2. Larry W. Mays, (2004), Urban Stormwater Management Tools, McGraw-Hill Companies
3. J Parkinson, O Mark (2005) Urban Stormwater Management in Developing Countries, IWA Publishing

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ar16/preview -"Urban Utilities Planning :Water Supply,Sanitation and Drainage,Prof.Debapratim Pandit,IIT Kharagpur.
2. https://nptel.ac.in/courses/105106115 - :Infrastructure Planning and Management" , Prof. A. Veeraragavan, Dr. Ashwin Mahalingam

21CEE21 **FINITE ELEMENT METHOD**

L	T	P	C
3	0	0	3

PREAMBLE:

To develop a thorough understanding of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in Civil Engineering.

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

1. To understand the basics of finite element formulation.
2. To formulate the stiffness matrix for beam, truss and framed structures.
3. To apply finite element formulations to solve one-dimensional problems.
4. To apply finite element method to solve two dimensional problems.
5. To apply finite element method to analyze plate bending problems.

UNIT 1 INTRODUCTION **9**

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT 2 STIFFNESS MATRIX FORMULATION **9**

Introduction to Discrete and Continua elements – Discrete Elements - Direct stiffness method - Special characteristics of stiffness matrix - Assemblage of elements – Boundary condition & reaction

- 2D – truss element - 2D - beam element - Analysis of framed Structures - Basic steps in finite element analysis - Differential equilibrium equations - strain displacement relation - linear constitutive relation - Numerical methods in finite element analysis- Gauss elimination method.

UNIT 3 ONE DIMENSIONAL PROBLEMS **9**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Continua Elements - Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function. Linear and quadratic elements - Lagrange & Serendipity elements. Strain displacement matrix - element stiffness matrix and nodal load vector. Natural frequencies of longitudinal vibration and mode shapes.

UNIT 4 TWO DIMENSIONAL PROBLEMS **9**

Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements. Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) Convergence criteria for isoparametric elements

UNIT 5 ANALYSIS OF PLATES **9**

Introduction to Plate Bending Problems - displacement functions – Analysis of Thin Plate - Analysis of Thick Plate - Analysis of Skew Plate, Finite Element Analysis of Shell, plane stress and plane strain analysis, Example problem using any general-purpose finite element software

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, ButterworthHeinemann,2018.
2. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.

REFERENCES:

1. Krishnamoorthy, C. S, Finite Element Analysis - Theory and Programming, McGraw - Hill, 1995.
2. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

e-RESOURCES:

1. https://www.engr.uvic.ca/~mech410/lectures/FEA_Theory.pdf
2. https://www.math.uci.edu/~chenlong/226/Ch2FEM.pdf

21CEE22 **BRIDGE ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

The primary objective of this course is to study the loads and forces on bridges , It also imparts the knowledge on design of several types of bridges and check the stability requirements on bridge

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

1. Describe components and types of bridges and understand economical span.
2. Design of reinforced concrete slab culvert.
3. Design of slab bridge by Pigeaud's method load distribution
4. Design the sub structures.
5. Apply the principles in the design of bridge foundations.

PREREQUISITE:

UNIT 1 INVESTIGATIONS AND PLANNING 9

Components of a bridge structure – inspection and site investigations for a bridge – Determination of linear waterway, design discharge and scour depth – Economical span – Types and choice of bridges. Standard specifications for road bridges and railway bridges – general design considerations.

UNIT 2 CULVERTS 9

General – design principles, considerations and criteria of pipe culverts, slab culvert, box culvert, and causeways – Design of R.C slab culvert.

UNIT 3 SLAB BRIDGE AND T- BEAM BRIDGES 9

Slab Bridge - Distribution of concentrated loads by IRC and Pigeaud's Method – Design of T- beam bridge – design of main girder– Design of cross girders – Load distribution by Courbon's Method.

UNIT 4 SUBSTRUCTURES AND BEARINGS 9

Definition – pier and abutment caps – materials for piers and abutment - piers – forces due to wave action and collision – Design procedure for pier and abutment. Bearings – types of bearing – functions.

UNIT 5 BRIDGE FOUNDATION 9

General Aspects - Types of foundation - Pile foundations - Well foundation -Component of well foundation - Design procedure for Pile and well foundation - Caisson foundations.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. D.Johnson victor, "Essentials of Bridge Engineering", 6th Edition, Oxford and IBH Publishing Co., New Delhi, 2019
2. Krishna Raju N, "Design of bridges", 5th Edition, Oxford and IBH Publishing Co., New Delhi, 2019.

REFERENCES:

1. Ponnuswamy.S, "Bridge Engineering", 3rd edition, Tata McGraw Hill Publishing Co., Ltd, New Delhi, 2017.
2. Jagadeesh T.R , Jayaram M.A , "Design of bridge structures", PHI Learning Private limited, 2010.

e-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105216/
2. https://www.udemy.com/course/fundamentals-of-bridge-designyour-way-to-be-bridge-designer/

21CEE23 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

L	T	P	C
3	0	0	3

PREAMBLE:

To understand the behaviour of structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions.

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

1. Develop the equations of motion for SDOF and MDOF system and to evaluate the natural frequencies and mode shapes.
2. Explain the elements of engineering seismology, characteristics of earthquake and seismicinstrumentation.
3. Explain the behavior of various types of structures under earthquake
4. Determine the forces in a structure due to earthquake
5. Design earthquake resistant building structures

UNIT 1 INTRODUCTION TO DYNAMICS 9

Dynamics - Degree of freedom – Free and forced vibration - Idealization of structure as Single Degree of Freedom (SDOF) and Multi degree of freedom (MDOF) system – D'Alemberts Principles - Formulation of equation of motion for SDOF system and MDOF system –- Evaluation of natural frequencies and modes - Effect of damping.

UNIT 2 SEISMOLOGY 9

Elements of Engineering Seismology – Seismic hazard - Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction – Liquefaction of soil - Seismic zone map – Response spectra.

UNIT 3 EARTHQUAKE EFFECTS ON STRUCTURES 9

Inertia force on structures – load transfer path – Effect of architectural features on behavior of structures – Hysteretic Behaviour of RCC, steel and prestressed concrete - Pinching Effect – Bouchinger Effects - Energy dissipation - P-delta effect - storey drift - Behavior of brick masonry, stone masonry and reinforced concrete structures under past earthquakes – typical failures - Causes of damage –- Lessons learnt from past earthquakes.

UNIT 4 EARTHQUAKE LOAD ANALYSIS 9

Design spectra – Codal provision – Different methods of earthquake analysis –- Analysis of structure by Equivalent static method – Analysis of structure by Response spectrum method – Introduction to time-history method of analysis

UNIT 5 EARTHQUAKE RESISTANT DESIGN 9

Philosophy of earthquake resistant design - Planning considerations and Architectural concepts - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member, Ductile detailing of beam-column joints and footing – Concept and principle of shear wall - Introduction to performance based seismic design - Seismic isolation principles and methods.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.

REFERENCES:

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.
3. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007.
4. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur, 2002.

e-RESOURCES:

1. https://onlinelibrary.wiley.com/journal/10969845
2. https://www.sciencedirect.com/book/9781845695187/structural-dynamics-of-earthquake-engineering

21CEE24 **ADVANCED DESIGN OF RCC STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

This course deals with the designing of rcc structure with the latest code of practice as per the Indian Standard. It inculcates basic knowledge on designing major industrial structures like girders, high rise chimneys and pre-engineered thin walled structures.

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

1. Identify and explain the requirements of various industries and get an idea about the materials used and planning of various industrial components
2. Summarize the functional requirements for concrete water tanks.
3. Design special concrete slab bridges
4. Design special RC structures like corbels, silos, bunkers, chimneys.
5. Explain the detailing for earthquake resistant structures

UNIT 1 DESIGN OF SPECIAL RC ELEMENTS 9

Design of slender columns - concrete confined by reinforcement - provision for ties in reinforced concrete slab - frame system - Design of cast-in-situ joints in frames - design of RC walls - ordinary and shear walls - design of corbels

UNIT 2 CONCRETE WATER TANKS 9

Design of Circular tanks - Hinged and fixed at the base - IS method of calculating shear forces and moments - Hoop tension - Design of intz type tank - Dome - Ring girders - Conical dome -Staging - Bracings - Raft foundation - Design of rectangular tanks - Approximate methods and IS methods - Design of underground tanks - Design of base slab and side wall - Check for uplift.

UNIT 3 REINFORCED CONCRETE SLAB BRIDGES 9

Design of solid slab bridges for IRC loading - Design of kerb - Design of tee beam bridges - Courbon's theory - Pigeaud's curves - Design of balanced cantilever bridges - Deck slab - Main girder - Design of cantilever - Design of articulation.

UNIT 4 BUNKERS AND SILOS 9

Design of square bunker - Side Walls - Hopper bottom - Top and bottom edge beams - Design of cylindrical silo - Wall portion - Design of conical hopper - Ring beam at junction

UNIT 5 EARTHQUAKE RESISTANT STRUCTURES DETAILING 9

Earthquake forces - Bureau of Indian Standards for Earthquake resistant design - earthquake magnitude and intensity - basic seismic coefficients and seismic zone factors - design forces - design factors - Analysis of structures- choice of method for multistoreyed buildings. Ductile detailing of frames for seismic forces - general principles.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Krishna Raju N, “Advanced Reinforced Concrete Design”, CBS Publishers and Distributors, 2016.
2. P.C.Varghese, “Advanced Reinforced Concrete Design”, Prentice Hall of India Pvt. Ltd., 2010.

REFERENCES:

1. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publilcations, Pune, 2013.
2. N. Krishna Raju, “Design of Bridges”, Oxford and IBH Publishing Co., Pvt Ltd., New Delhi, 2009.

e-RESOURCES:

1. http://nptel.ac.in/courses/105105105/ , “Design of Reinforced Concrete Structures”, Prof. Nirjhar Dhang”,IIT
2. Kharagpur. . http://nptel.ac.in/courses/105101004/, “Introduction to Earthquake Engineering”, Dr.R.S.Jangid, IIT Bombay.

21CEE25 **PREFABRICATED STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart knowledge to students on modular construction, industrialized construction and design principles of prefabricated elements and construction methods.

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

1. Explain the design principles and stages of loading in precast construction.
2. Demonstrate about panel systems, roof and floor slabs, shear walls.
3. Solve the problems in joint flexibility, joint deformation and disuniting of structures.
4. Acquire knowledge about precast joint and connections, sealants.
5. Identify and explain the effect of abnormal loads in prefabricated structures.

UNIT 1 INTRODUCTION **9**

Need for prefabrication – Principles of prefabrication – Modular coordination – Standarization – Materials – Systems – Production – Transportation – Erection.

UNIT 2 PREFABRICATED COMPONENTS **9**

Behaviour of structural components - Large panel constructions - Roof and floor slabs - Wall panels – Beams - Columns - Shear walls.

UNIT 3 DESIGN PRINCIPLES **9**

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

UNIT 4 JOINTS AND CONNECTIONS **9**

Types of Joints - based on action of forces - compression joints - shear joints - tension joints - based on function - construction, contraction, expansion. Types of sealants - Types of structural connections - beam to column - column to column - beam to beam - column to foundation.

UNIT 5 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.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA, 1991.
2. Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties And Usage", Applied Science Publishers , London And New Jersey, 1982.

REFERENCES:

1. Koncz T., “Manual of precast concrete construction”, Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.

21CEE26 **PRESTRESSED CONCRETE STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

To introduce knowledge on the basic principles and design philosophy of prestressed concrete structures. Analysis and design of prestressed concrete elements such as beams, tanks and pipes. To impart knowledge in analysis and design of anchorage zone.

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

1. Analysis of prestressed sections.
2. Calculate loss of prestress and deflection of sections.
3. Design anchorage zone for prestressed members.
4. Analysis composite and continuous members.
5. Design tanks, pipes and poles.

UNIT 1 THEORY AND BEHAVIOUR 9

Basic Concepts – Pre tensioning - Post tensioning - Advantages and Disadvantages - systems and methods of prestressing - Materials - Characteristics of concrete - Characteristics of high tensile steel. Analysis of sections: Calculating fibre stresses for various section (Rectangle, I, T) of simply supported beam due to prestressing force, dead and live load - Stress concept - Strength concept - Load balancing concept.

UNIT 2 LOSSES OF PRESTRESS AND DEFLECTION 9

Losses of prestress: Causes for losses in prestressed – calculation of losses - losses due to elastic shortening, creep, shrinkage, Relaxation losses, friction and anchorage losses. Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit states.

UNIT 3 DESIGN CONCEPTS 9

Flexural strength – Basic concepts in selection of cross section for bending - Check for flexural and shear capacity based on I.S.1343 Code (Rectangle, I, T). Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

UNIT 4 COMPOSITE BEAMS AND CONTINUOUS BEAMS 9

Analysis of composite beams – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT 5 MISCELLANEOUS 9

Design of circular water tanks, pipes and poles. Partial prestressing - Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Krishna Raju N., "Prestressed Concrete", 6th Edition, Tata McGraw Hill Company, New Delhi, 2018.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2010.

REFERENCES:

1. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", First Edition (12th reprint), CBS Publishers and Distributers Pvt. Ltd, 2023.
2. Dayaratnam.P., "Prestressed Concrete Structures", 6th Edition, Oxford and IBH Publishing Co Pvt. Ltd., 2018.
3. Sinha. N.C and Roy.S.K., "Fundamentals of prestressed concrete", 3rd Edition, S.Chand and Co Ltd., 2011.
4. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2010.
5. IS1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012.

e-RESOURCES:

1. https://nptel.ac.in/courses/105/106/105106117/ ―Prestressed Concrete Structures‖, Dr. Amlan, K Sengupta and Prof. DevdasMenon, Department of Civil Engineering, IIT, Madras.
2. https://www.udemy.com/course/analysis-and-design-of-prestressed-concrete-part-1/

21CEE27 **ADVANCED STEEL STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

To study the behaviour of members and connections, analysis and design of Industrial buildings and roofs, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

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

1. Design of roof truss and its components in industrial structures.
2. Design bolted and welded connections.
3. Plastic analysis of the structures.
4. Design of towers.
5. Design of light gauge steel structures.

UNIT 1 INDUSTRIAL BUILDINGS 9

Roof trusses – Roof and side coverings – design of loads - design of purlins and elements of truss and end bearing – gable column, gable rafter, side rails, gable wind girder and end bracings of industrial buildings.

UNIT 2 CONNECTIONS 9

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections HSFG bolted connections.

UNIT 3 PLASTIC ANALYSIS AND DESIGN 9

Introduction – Shape factors – Static, Kinematic and uniqueness theorems – Combined mechanisms – Analysis and design of continuous beams and single bay single storey portal frames – Moment redistribution – Effect of axial force and shear force on plastic moment.

UNIT 4 TOWERS 9

Basic structural configurations - free standing and guyed towers - wind loads - foundation design - design criteria for different configurations and transmission line towers.

UNIT 5 LIGHT GAUGE STEEL STRUCTURES 9

Types of cross sections - local buckling and lateral buckling - concepts of elastic width – design of compression and tension members, beams, deflection of beams and design of beam webs.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. S K Duggal., “Limit State design of steel Structures”, Mc. Graw Hill Education (India) Private Limited, New Delhi, 2019.
2. Subramanian.N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2019.

REFERENCES:

1. Gaylord E.H, Gaylord N.C. and Stallmeyer, J.E, Design of Steel Structures, 3rd edition, McGraw-Hill Publications, 1992.
2. Dayaratnam.P., "Design of steel structures", 2nd Edition, S.Chand & Company Ltd., New Delhi,.
3. Shiyekar. M.R., "Limit State Design in Structural Steel", PHI Learning Private Limited, Delhi, 2nd Edition, 2013.
4. Bhavikatti.S.S, “Design of Steel Structures” By Limit State Method as per IS:800–2007, IK International Publishing House Pvt. Ltd., 2009
5. IS 800:2007, General Construction in Steel-Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.
6. IS 875:1987 (Part 1), Code of practice for design loads (other than earthquake) for buildings and structures (Second revision), Bureau of Indian Standards, New Delhi, 1987.
7. IS 875:1987 (Part 2), Code of practice for design loads (other than earthquake) for buildings and structures (Second revision), Bureau of Indian Standards, New Delhi, 1987.
8. IS 875:2015 (Part 3), Code of practice for design loads (other than earthquake) for buildings and structures (Third revision), Bureau of Indian Standards, New Delhi, 2015.
9. IS 811 – 1987, Specification for cold formed light gauge structural steel sections, (Second revision), Bureau of Indian Standards, New Delhi, 1989.
10. IS 801-1975, code of practice for use of cold-formed light gauge steel structural members in General building construction (first revision), Bureau of Indian Standards, New Delhi, 1976.

e-RESOURCES:

1. http://www.nptel.ac.in/courses/105106112/ ―Design of steel structures‖, Prof. S.R.Satish Kumar and Prof. A.R.Santha Kumar, Indian Institute of Technology, Madras.
2. http://www.steel-insdag.org/TM_Contents.asp ―Prof. Rangachari Narayanan, Retired Head of the Education and Publications Division, The Steel Construction Institute, England‖, Institute for Steel Development & Growth, Kolkata.

21CEE31 **SOLID & HAZARDOUS WASTE MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

The objectives of this course elaborates to apply basic understanding of sources , types, collection, transport, processing techniques and disposal of solid and hazardous waste.

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

1. Discuss the sources, types and characteristics of municipal solid waste management.
2. Plan for waste minimization techniques of municipal solid waste.
3. Select suitable method of collection and conveyance of municipal solid waste.
4. Explain the possible treatment method of hazardous waste.
5. Identify and explain proper disposal method of solid waste.

UNIT 1 MUNICIPAL SOLID WASTE MANAGEMENT 9

Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes -Public health and environmental effects. Elements of solid waste management -integrated management-Public awareness; Role of NGO‘s.

UNIT 2 ON-SITE STORAGE AND PROCESSING 9

On-site storage methods - Purpose and economic benefits of onsite processing- Effect of storage-Desirable characteristics of containers- materials used for containers - segregation of solid wastes - Public health and economic aspects of open storage - source reduction of waste - Reduction, Reuse and Recycling.

UNIT 3 COLLECTION AND TRANSPORT 9

Methods of Residential and commercial waste collection - Collection vehicles - Manpower - Collection routes -Transfer stations - Selection of location, operation & maintenance - Physical processing techniques and Equipment - Types and factors affecting composting process - Biomethanation.

UNIT 4 HAZARDOUS WASTE MANAGEMENT 9

Definition of hazardous wastes - Sources and characteristics - Hazardous waste regulations -Minimization of Hazardous waste - Handling and storage of hazardous waste - Physical and chemical treatment of hazardous waste - E waste - Solidification - Incineration.

UNIT 5 DISPOSAL 9

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

TOTAL = 45 PERIODS

TEXT BOOKS:

1. T.V.Ramachandra, Management of Municipal Solid Waste, Capital Publishing Company, New Delhi, 2017.
2. Tchobanoglous, G., Theisen, H. M., and Eliassen, R., Solid. Wastes: Engineering Principles and Management Issues.McGraw Hill, New York, 2016.

REFERENCES:

1. Bhide A.D. and Sundaresan, B.B. Solid Waste Management Collection, Processing and Disposal, 2001
2. Government of India, Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, New Delhi, 2000.

e-RESOURCES:

1. http://nptel.ac.in/courses/105106056/, Solid and Hazardous Waste Management, Dr. Indumathi Nambi, IIT Madras.
2. http://nptel.ac.in/courses/120108005, Municipal Solid Waste Management, Prof. T.V. Ramachandra, IISc Bangalore.

21CEE32 **MUNICIPAL SOLID WASTE MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

The objectives of this course elaborate to apply basic understanding of sources, types, collection, transport, processing and disposal of municipal solid waste.

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

1. Identify various types of solid wastes and their sources
2. Select suitable method of collection and conveyance of municipal solid waste.
3. Analyze the activities associated with the management of solid waste
4. Explain the offsite processing techniques and equipment of solid waste.
5. Design a sanitary landfill for disposal of solid waste

UNIT 1 SOLID WASTE **9**

Definitions and Perspectives - Types of solid wastes - Sources of solid wastes- Properties of solid wastes - Physical and chemical characteristics of municipal solid waste - Functional elements of solid waste management - Municipal solid waste management and handling rules - Role of Non-government organization - Examples - Methods of public awareness.

UNIT 2 ENGINEERING SYSTEMS FOR SOLID WASTE MANAGEMENT **9**

Solid waste generation - Methods of generation - Factors affecting generation - On-site storage –Effects of storage - Collection of solid wastes - Factors affecting - Methods of Residential and commercial waste collection system -Transfer and transport – Transfer station - Integrated solid waste Management concepts.

UNIT 3 ENGINEERING SYSTEMS FOR RESOURCE AND ENERGY RECOVERY **9**

Processing techniques - RRR approach, materials-recovery systems - Recovery of biological conversion products; Recovery of thermal conversion products - Recovery of energy from conversion products - Materials and energy recovery systems.

UNIT 4 PROCESSING OF WASTES **9**

Objectives of waste processing – Types of physical processing techniques - Equipment - Methods of composting -factors affecting composting – Uses of composting - Biomethanation - Functions - Benefits – Comparison of Incineration and Pyrolysis process.

UNIT 5 ENGINEERING DISPOSAL OF SOLID WASTE **9**

Sanitary landfills - Site selection, design and operation of sanitary landfills - Methods of sanitary landfill – Advantages of sanitary landfill - Management of leachate and landfill gas - Landfill bioreactor – Dumpsite Rehabilitation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. ―Solid. Wastes: Engineering Principles and Management Issues.McGraw Hill, New York, 2016.
2. Vesilind PA, Worrell W and Reinhart D, Brooks-Cole ,Solid Waste Engineering, Thomson Learning Inc., 2010, 2nd Edition.

REFERENCES:

1. Bhide A.D. and Sundaresan, B.B. ― Solid Waste Management Collection, Processing and Disposal, 2001
2. Tchobanoglous G and Kreith F, Handbook of Solid Waste Management, McGraw-Hill Education, 2002, 2nd Edition

e-RESOURCES:

1. http://nptel.ac.in/courses/105106056/, ―Solid and Hazardous Waste Management‖, Dr. Indumathi Nambi, IIT Madras.
2. http://nptel.ac.in/courses/120108005, ―Municipal Solid Waste Management‖, Prof. T.V. Ramachandra, IISc Bangalore.

21CEE33 **PUBLIC HEALTH ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

The aim of this course is to Create higher standard of knowledge on healthcare system and services Prioritize advanced technologies for the diagnosis and treatment of various diseases.

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

1. Understand the various components of water supply scheme and design of intake structure and conveyance system for water transmission
2. Design an appropriate treatment system for the water available at the source.
3. Arrive the quantity of water for given city and to estimate the storage requirement of reservoir
4. Estimate the quantity of wastewater generation.
5. Design of sewer line and explain the necessity of pump and plumbing system.

UNIT 1 WATER SUPPLY **9**

Surface and Subsurface water - Predicting demand for water- Impurities of water and their significance - Physical, chemical and bacteriological analysis - Waterborne diseases - Standards for potable water - Intake Structures

UNIT 2 WATER TREATMENT **9**

Objectives - Unit operations and processes - Principles and functions of water treatment plant units-aerators , flash mixers, Coagulation and flocculation - Clarifloccuator - sand filters - Disinfection - Removal of iron and manganese - Defluoridation - Softening - Desalination process - Residue Management - Construction, Operation and Maintenance aspects

UNIT 3 WATER DISTRIBUTION **9**

Requirements of water distribution - Components - Service reservoirs - Functions and drawings - Network design - Computer applications - Analysis of distribution networks - Layout of distribution System - Leak detection methods - Components of house service connection.

UNIT 4 SEWERAGE SYSTEM **9**

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

UNIT 5 DESIGN OF SEWER **9**

Sewerage - Hydraulics of flow in sewers - Objectives - Design period - Design of sanitary and storm sewers - Laying, joining and testing of sewers - Sewer appurtenances - Pumps - Selection of pumps and pipe drainage - Plumbing System for buildings - One pipe and two pipe systems.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Garg, S.K., Environmental Engineering, Vol I&Vol II, Khanna Publishers, New Delhi, 2014.
2. Punmia B C, Ashok K Jain and Arun K Jain., Waste Water Engineering, Laxmi Publications Pvt. Ltd., New Delhi,2013.

REFERENCES:

1. Birde G.S and Birde J.S., Water Supply and Sanitary Engineering, Dhanpat Raj Publishing Co., New Delhi, 2015.
2. Manual on Sewage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.

e-RESOURCES:

1. http://nptel.ac.in/courses/105104102/ Water and wastewater Engineering, Dr. P. Bose, IIT Kanpur.
2. http://nptel.ac.in/courses/105104102/2, Water and Waste water Engineering, Prof. C. Venkobachar, Prof. Ligy Philip, Prof. B.S. Murty, IIT Madras.

21CEE34 **CONSTRUCTION PROJECT MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

To familiarize the types of organization and their impact on and suitability to construction projects and to impart the knowledge on design and construction procedures along with labour, material and equipment utilization.

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

1. Coordinate effectively with all the project participants.
2. Discuss the professional construction management and interpersonal Behavior in Project Organizations.
3. Explain the modern trends in project management viz. design and construction.
4. Apply value engineering practices and measures to improve job site productivity.
5. Estimate costs associated with construction projects.

UNIT 1 ORGANIZING FOR PROJECT MANAGEMENT 9

Organizing for Project Management -Project Management - Trends in Modern Management -Strategic Planning and Project Programming - Organization of Project Participants - Traditional Designer - Contractor Sequence.

UNIT 2 THE OWNER'S PERSPECTIVE 9

Professional Construction Operation - Leadership and Motivation -Interpersonal Behavior in Project Organizations - Perceptions of Owners and Contractors

UNIT 3 DESIGN AND CONSTRUCTION PROCESS 9

Design and Construction Process - Design and Construction as an Integrated System - Innovation and Technological Feasibility - Innovation and Economic Feasibility - Design Methodology -Functional Design.

UNIT 4 LABOUR AND EQUIPMENT UTILIZATION 9

Value Engineering - Construction Planning - Industrialized Construction and Prefabrication - Computer-Aided Engineering - Labour Productivity - Factors Affecting Job-Site Productivity

UNIT 5 COST ESTIMATION 9

Cost Estimation - Costs associated with Constructed Facilities - Approaches to Cost Estimation -Type of Construction Cost Estimates - Cost Indices - Applications of Cost Indices to Estimating -Estimate Based on Engineer's List of Quantities

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Chitkara, K.K.,"Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury, S. "Project Management", Tata McGraw-Hill Publishing Company, New Delhi, 2008.

REFERENCES:

1. Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pittsburgh, 2000.
2. Martin Loosemore, "Essentials of Construction Project Management", University of New South Wales Press Ltd, Australia, 2004.

e-RESOURCES:

1. http://nptel.ac.in/courses/105103093/ Construction Planning and Management, Prof. Arbind Kumar Singh, IIT Guwahati.
2. https://www.youtube.com/watch?v=Cz9FgtbMo_8/David Arditi, PhD, Professor and Director, Construction Engineering and Management Program, Illinois Institute of Technology, IL, USA.

21CEE35 **HOUSING PLANNING AND MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

The objective of the course is to train the students to have a comprehensive knowledge of planning, design, evaluation, construction and financing of housing projects. The course focuses on cost effective construction materials and methods.

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

1. Identify and explain the basics of housing and policies.
2. Describe the housing programmes and their improvements.
3. Plan and design the housing projects.
4. Explain the new construction techniques and construction materials.
5. Evaluate the housing finance strategies and project appraisal.

UNIT 1 INTRODUCTION TO HOUSING 9

Definition of Basic Terms – House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies including Slum Housing Policy, Principle of Sustainable Housing – Integrated approach on arriving holding capacity and density norms - All basic infrastructure consideration - Institutions for Housing at National, State and Local levels.

UNIT 2 HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods- Plotted land development programs, Open Development Plots, Apartments, Gated communities, Townships, Rental Housing, Co-operative Housing, Slum Housing Programmes – Slum improvement – Slum redevelopment and Relocation – Use of GIS and MIS in Slum Housing Projects,, Role of Public housing agencies, and Private sector in supply , quality, infrastructure and pricing – Role of Non-Government Organizations in slum housing.

UNIT 3 PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Land Use and Soil suitability analysis -Building Bye Laws and Rules and Development Control Regulations - Site Analysis, Layout Design, Design of Housing Units (Design Problems) – Housing Project Formulation.

UNIT 4 CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Materials and Methods of Construction- Green building concept-Building Centers – Concept, Functions and Performance Evaluation.

UNIT 5 HOUSING FINANCE AND PROJECT APPRAISAL 9

Evaluation of Housing Projects for sustainable principles – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy- Public Private Partnership Projects – Viability Gap Funding - Pricing of Housing Units (Problems).

TOTAL = 45 PERIODS

TEXT BOOKS:

1. S 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. Wiley- Blackwell, "Neufert Architects" Data, 4th Edition, Blackwell Publishing Ltd, 2012.
2. Francis Cherunilam and Odeyar D Heggade, "Housing in India", Himalaya Publishing House, Bombay, 1997.

e-RESOURCES:

1. https://nptel.ac.in/courses/124107001/Housing Policy & Planning, Dr. Uttam K. Roy, IIT Roorkee.
2. https://nptel.ac.in/courses/105106188/ Infrastructure Planning and Managements, Dr. AshwinMahalingam, IIT Madras.

21CEE36 **BUILDING PLANNING AND SERVICES**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the various aspects of pumps and machinery involved in Civil Engineering practice and the principles of electrical and air conditioning facilities, acoustics and vibration control systems and information systems involved.

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

1. Distinguish the different income groups in India and concept of climatology for housing requirements
2. Apply the concept of Building byelaws in planning of the House
3. Classify various types of plumbing and power supply systems
4. Discuss the maintenance of building and its various repairing techniques
5. Discuss fire safety requirement of a building

UNIT 1 BUILDING CLASSIFICATION 9

Classification of buildings – row houses (chawls) –Brief information about Duplex houses, Apartments, housing colonies for HIG, MIG, LIG and EWS in India – Sizes of plots. Elements of climate, climate zones in India, climate and comfort, building orientation, factors affecting orientation, Sun, wind, optimum orientation of a building, principles of anthropometry.

UNIT 2 BUILDING BYELAWS AND REGULATIONS 9

Building byelaws, objectives of byelaws, minimum plot sizes, open spaces, minimum standard dimensions, built-up area, super built up area, plinth area, carpet area, floor area and FAR, FSI, lighting & ventilation, rules governing parking, fire, water supply -provisions of NBC, HVAC. Line plans for a residential building of a minimum of three rooms including W/C, bath, and staircase as per principles of planning - Line plans for public building - school building, primary health center, post office, function hall, and library.

UNIT 3 PLUMBING SYSTEMS AND ELECTRICAL MAINTENANCE 9

Drainage, gas pipelines, drinking water pipelines, Plumbing accessories installation, Plumbing fixtures, sanitary fixtures, RO and water features and services. Basics of electricity – Single / Three phase supply– Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations – Solar power system.

UNIT 4 MAINTENANCE AND SPECIAL REPAIRS 9

Repairs to damaged part of the flooring, Removal of stains from concrete and terrazzo floor, Antitermite treatment (in building, foundations, floors and woodwork) Repair of water storage sumps and tanks, Repair of any joints i.e. wall-beam joint leak, beam column and slab-beam, joints, water proofing and grouting.

UNIT 5 FIRE SAFETY INSTALLATION 9

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials in construction of staircases and lift lobbies. Special features required for physically handicapped and elderly in buildings – Heat and smoke detectors – Fire alarm system, Snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. N.Kumara Swamy and A.Kameswara Rao,"Building Planning and Drawing", 8th Edition, Charotar Publications, 2010.
2. H.W. Harrison and P.M. Trotmanm, "BRE Building elements, Building service", BRE Press Publishers, 2000.

REFERENCES:

1. B.S. Gahlot and Sanjay Sharma, "Building repair and maintenance and management", CBS Publishers, 1st Edition, 2006.
2. E.R.Ambrose, "Heat Pumps and Electric Heating", John and Wiley and Sons, Inc., New York,1968.

21CEE37 **CONTRACT LAWS AND REGULATIONS**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the various types of construction contracts and their legal aspects and provisions, tenders, arbitration, legal requirements and labour regulations.

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

1. Discuss the different types of contracts in construction, arbitration and legal aspects and its provisions.
2. Apply the general principles of the law of contract and tenders.
3. Discuss the practical and social context in which rules operate.
4. Explain the common law, equitable and statutory rules relating to enforceable agreements.
5. Explain the different labor regulations.

UNIT 1 CONSTRUCTION CONTRACTS **9**

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

UNIT 2 TENDERS **9**

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Transparency in Tenders Act.

UNIT 3 ARBITRATION **9**

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

UNIT 4 LEGAL REQUIREMENTS **9**

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

UNIT 5 LABOUR REGULATIONS **9**

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen‘s Compensation Act – Indian Factory Act – Tamil Nadu Factory Act – Child Labour Act - Other Labour Laws.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Jimmie Hinze, Construction Contracts, Second Edition, McGraw Hill, 2001.
2. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, Sixth Edition, McGraw Hill, 2000.

REFERENCES:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982.
2. Tamilnadu PWD Code, 1986.

e-RESOURCES:

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104161/lec32.pdf
2. https://nptel.ac.in/courses/105104161/Priciples of Construction Management, Prof.Sudhir Misra, IIT Kanpur.

21CEE41 **CONSTRUCTION EQUIPMENT AND MACHINERY**

L	T	P	C
3	0	0	3

PREAMBLE:

To study and understand the various types of equipment's used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

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

1. Develop knowledge on planning of equipment and selection of equipment
2. Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment
3. Develop the knowledge on special construction equipment's
4. Apply the knowledge on asphalt and concrete plants
5. Apply the knowledge and select the proper materials handling equipment

UNIT 1 CONSTRUCTION EQUIPMENT SELECTION 9

Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis - Safety Management.

UNIT 2 EQUIPMENT FOR EARTHWORK 9

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT 3 OTHER CONSTRUCTION EQUIPMENTS 9

Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

UNIT 4 ASPHALT AND CONCRETING EQUIPMENTS 9

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT 5 MATERIALS HANDLING EQUIPMENT 9

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Peurifoy, R.L., Schexnayder, C. and AviadShapira., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2010.
2. Granberg G.,Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006

REFERENCES:

1. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 2001.
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, DhanpatRai and Sons, 2010.
3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008.

e-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/103/105103206/
2. http://www.nitttrc.edu.in/nptel/courses/video/105104161/lec12.pdf

21CEE42 **FORMWORK ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

On completion of this course the students will be able to know the detailed planning of formwork, design of forms and erection of form work.

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

1. To understand the overall and detailed planning of formwork.
2. To impart knowledge on formwork materials, accessories, pressures and labour requirement.
3. To develop the conceptual understanding of design, construction and erection of formwork.
4. To impart the knowledge about different types of form work used for special structures.
5. To understand the errors in design and judge the formwork failures through case studies.

UNIT 1 INTRODUCTION TO FORM WORK 9

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

UNIT 2 FORMWORK MATERIALS ASSESORIES & PRESSURES 9

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

UNIT 3 FORMWORK DESIGN 9

Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.

UNIT 4 FORMWORK FOR SPECIAL STRUCTURES 9

Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.

UNIT 5 CASE STUDIES 9

Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi - story building construction – vertical and horizontal elements used in the industry.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Peurify R.L and Oberlender G.D , Formwork for Concrete Structures, McGraw Hill Education India ,2015
2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012.

REFERENCES:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, ACI,Detroit, 1996

e-RESOURCES:

1. https://elearn.cmti.co.in/learn/Formwork

21CEE43 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction projects.

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

1. Plan and schedule the resources available for a project.
2. Discuss the scheduling procedure and techniques for construction projects.
3. Explain the elements of cost control and monitoring of construction projects.
4. Explain the concept of gathering and using project information.
5. Differentiate the different database models used for information transfer.

UNIT 1 CONSTRUCTION PLANNING AND SCHEDULING 9

Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships Among Activities - Estimating Activity Durations - Estimating Resource Requirements for Work Activities.

UNIT 2 SCHEDULING WITH CONSTRAINTS 9

The Critical Path Method - Scheduling with Resource Constraints and Precedence - Use of Advanced Scheduling Techniques - Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Tradeoffs.

UNIT 3 COST CONTROL, MONITORING AND ACCOUNTING 9

The Cost Control Problem - The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates - Relating Cost and Schedule Information.

UNIT 4 ORGANIZATION AND USE OF PROJECT INFORMATION 9

Value engineering-Types of Project Information - Accuracy and Use of Information - Computerized Organization and Use of Information - Organizing Information in databases.

UNIT 5 DATABASE MODEL 9

Relational Model of Databases - Other Conceptual Models of Databases - Centralized Database Management Systems - Databases and Applications Programs - Information Transfer and Flow.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Chitkara, K.K., Construction Project Management Planning, Scheduling and Control‖, Tata McGraw Hill Publishing Co., New Delhi, 2005.
2. Srinath,L.S., Pert and CPM Principles and Applications, Affiliated East West Press, 2001.

REFERENCES:

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamentals Concepts for Owners‖, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications‖, Wiley, New York, 1995.
3. Willis, E.M., Scheduling Construction Projects, John Wiley & Sons, 1986.

e-RESOURCES:

1. https://books.google.co.in/books?isbn=1118826930/ Handbook for Construction Planning and Scheduling, Andrew Baldwin and David Bordoli.
2. http://nptel.ac.in/courses/105103093/ Construction Planning and Management, Prof. Arbind Kumar Singh, IIT Guwahati.

21CEE44 **SAFETY IN CONSTRUCTION**

L	T	P	C
3	0	0	3

PREAMBLE:

To know causes of accidents related to construction activities and human factors associated with this accident and understand the construction regulations and quality assurance in construction.

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

1. Visualize the safety issues at different stages of construction activity.
2. Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
3. Understand the safety requirements in material handling and Equipments and develop guidelines to ensure safety at construction site.
4. Learn the legal provisions with respect to the health and welfare of workers at construction site.
5. List out construction regulations and Indian standards for construction and demolition work

UNIT 1 INTRODUCTION **9**

Introduction to construction industry and safety issues in construction-Human factors in construction safety management-Roles of various groups and stake-holders in ensuring safety in construction industry -Framing of contract conditions onsafety and related matters –Relevance of ergonomics in construction safety

UNIT 2 SAFETY IN CONSTRUCTION OPERATIONS **9**

Safety in various construction operations - Excavation and filling - Under- water works - Underpinning & Shoring - Ladders & Scaffolds - Tunnelling - Blasting - Dismantling - Confined space Temporary Structures. Noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Effects of air pollution in Industry, air pollution episodes; Emission factors inventory and predictive equations. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

UNIT 3 CONSTRUCTION MACHINERY **9**

Safety in material handling and equipment's-Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles - excavators, graders and dozers - cranes - hoists & lifts - other lifting gears˜ wire ropes - chain-pulley blocks - mixers -conveyors- pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

UNIT 4 CONSTRUCTION ACT AND CODE OF PRACTICES **9**

Contract Labour (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building & Other Construction Work (RE & CS) Act, 1996 and Central Rules, 1998: Applicability, Administration, Registration, WelfareBoard & WelfareFund, Training of Building workers, 79 General Safety, Health & Welfare provisions. Code of Practices - -Preventive measures against Hazards at work places Part1 & 2

UNIT 5 SAFETY IN DEMOLITION WORK **9**

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision ,safe clearance zone, health hazardsfrom demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods–Case studies in construction sites against the fire accidents

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Hudson,R.,"ConstructionhazardandSafetyHandbook,ButterWorth's,1985.
2. Raymond Elliot Levitt, Nancy Morse Samelson, "Construction Safety Management, McGrawHill, London, 1987.

REFERENCES:

1. Jnathea D.Sime,"Safety in the Build Environment",London,1988.
2. Davies,V. J., and Tomasin,K.(1996).Construction safety hand book. Thomas Telford Publishing, London.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ce16/preview
2. https://alison.com/course/construction-safety-and-health

21CEE45 **ENERGY EFFICIENT BUILDINGS**

L	T	P	C
3	0	0	3

PREAMBLE:

To provide an understanding of the concept of energy consumption in buildings and design an energy efficient building.

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

1. Explain environmental energy supplies on buildings
2. Explain the passives solar heating, cooling system
3. Discuss the various aspects of day-lighting and electrical lighting in a building
4. Predict and design building ventilation and heat control for indoor comfort
5. Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

UNIT 1 CLIMATE **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT 2 PASSIVE SOLAR HEATING AND COOLING **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT 3 DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT 4 HEAT CONTROL AND VENTILATION **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT 5 DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL = 45 PERIODS

REFERENCES:

1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995

21CEE46 **ADVANCED CONSTRUCTION TECHNIQUES**

L	T	P	C
3	0	0	3

PREAMBLE:

To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.

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

1. Understand the modern construction techniques used in the sub structure construction.
2. Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
3. Understand the concepts used in the construction of special structures
4. Knowledge on Various strengthening and repair methods for different cases.
5. Identify the suitable demolition technique for demolishing a building.

UNIT 1 SUB STRUCTURE CONSTRUCTION 9

Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

UNIT 2 SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 9

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab-aerial transporting – Handling and erecting lightweight components on tall structures.

UNIT 3 CONSTRUCTION OF SPECIAL STRUCTURES 9

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

UNIT 4 REHABILITATION AND STRENGTHENING TECHNIQUES 9

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

UNIT 5 DEMOLITION 9

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984
2. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.

REFERENCES:

1. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
2. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
3. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.

e-RESOURCES:

1. https://www.digimat.in/nptel/courses/video/105103206/L01.html
2. https://archive.nptel.ac.in/courses/105/106/105106053/

21CEE47 **REPAIR AND REHABILITATION OF STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

This course provides the knowledge on quality of concrete, durability aspects, causes of deterioration. It is used to gain the knowledge on assessment of distressed structures, repairing of structures and demolition procedures.

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

1. Explain the assessment procedure for evaluating a damaged structure.
2. Identify and explain the design and construction errors in concrete construction.
3. Discuss the materials and techniques for repair distressed structures.
4. Select and explain suitable repair and demolition techniques for structures.
5. Explain the various techniques for strengthening of structures.

UNIT 1 MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance - repair and rehabilitation – necessity and classification of Maintenance - various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration - Diagnosis of causes and preventive measures.

UNIT 2 CHEMICAL CAUSES AND CORROSION 9

Chemical, salt, biological, chloride and sulphate attack - Carbonation - Alkali and silica reaction –Hydrolysis and leaching. Principles of corrosion – corrosion mechanism - corrosion process – corrosion protection techniques – corrosion inhibitators.

UNIT 3 DAMAGE ASSESSMENT 9

Purpose of assessment – rapid assessment – destructive testing systems – direct load tests – Non destructive testing systems – surface hardness methods – ultrasonic pulse velocity method – radiography methods – pulse attenuation method – radar technique - semi – destructive testing systems – core sampling and testing – pull out and pull off test – half cell potential measurements – break off test.

UNIT 4 TECHNIQUES FOR REPAIR AND DEMOLITION 9

Rust eliminators and polymer coating for rebars during repair – methods of repair for cracks - shoring and underpinning - Gunite / Shotcrete - Engineered demolition techniques – demolition tools – modern technology for demolition - Case studies.

UNIT 5 STRENGTHENING TECHNIQUES 9

Structural repair techniques for reinforced concrete - structural concrete strengthening – Jacketing technique – Externally bonding technique - external post – tensioning – strengthening by SIMCON – strategies for rehabilitation schemes.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. P. C. Varghese, ―Maintenance- Repair & Rehabilitation And Minor Works of Buildings‖, PHI Learning Pvt. Ltd 2014.
2. B.Vidivelli, ―Rehabilitation of concrete structures‖, Standard Publishers distributors, 2014.

REFERENCES:

1. M. S. Shetty, ―Concrete Technology Theory and Practice‖, S. Chand Co.- New Delhi 2005.
2. CPWD and Indian Buildings Congress- Hand book on Seismic Retrofit of Buildings-Narosa Publishers- 2008.

e-RESOURCES:

1. http://pwd.delhigovt.nic.in/pims/right_to_info/handbook.pdf.
2. http://indianconcreteinstitute.org/repair-and-rehabilitation.html.

21CEE51 **TRAFFIC ENGINEERING AND MANAGEMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

The overall aim of the course is to give an overview of traffic engineering, traffic regulation, management and traffic safety with an integrated approach in traffic planning as well.

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

1. Analyze traffic problems and plan for traffic systems various uses.
2. Design Channels, Intersections, signals and parking arrangements.
3. Develop Traffic management Systems.
4. Analyze a variety of traffic facilities and evaluate capacity and level of service.
5. Evaluate traffic impacts on the environment and safety.

UNIT 1 TRAFFIC PLANNING AND CHARACTERISTICS 9

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town ,country ,regional and all urban infrastructure – Towards Sustainable approach. – Land use & transport and modal integration.

UNIT 2 TRAFFIC SURVEYS 9

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses - Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT 3 TRAFFIC DESIGN AND VISUAL AIDS 9

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT 4 TRAFFIC SAFETY AND ENVIRONMENT 9

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT 5 TRAFFIC MANAGEMENT 9

Area Traffic Management System - Traffic System Management (TSM) with IRC standards –- Traffic Regulatory Measures- Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Kadiyali.L.R. "Traffic Engineering and Transport Planning",Khanna Publishers, Delhi, 2013.
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.

REFERENCES:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011.
2. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010.

e-RESOURCES:

1. https://nptel.ac.in/courses/105101008/ Dr. Tom V Mathew, IIT Bombay.
2. https://www.civil.iitb.ac.in/tvm/nptel/ceTseLn.html

21CEE52	RAILWAYS, AIRPORTS, DOCKS & HARBOUR	L	T	P	C
		3	0	0	3

PREAMBLE:

To expose the students to Railway planning, design, construction and maintenance, planning and design principles of Airports and Harbors.

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

1. Plan and design the components of railway
2. Describe construction, drainage and maintenance practices in railways
3. Design runway and taxiways at airports
4. Illustrate terminal design concepts
5. Identify and explain various harbor elements

UNIT 1 RAILWAY PLANNING 9

Significance of Road, Rail, Air and Water transports - Coordination of all modes to achieve sustainability - Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, - Track Stress, coning of wheels, creep in rails, defects in rails - Points and Crossings.

UNIT 2 RAILWAY CONSTRUCTION AND MAINTENANCE 9

Earthwork – Stabilization of track on poor soil – Soil suitability analysis - drainage - Calculation of Materials required for track laying - Construction and maintenance of tracks - Urban rail – Infrastructure for Metro, Mono and underground railways- Tunneling Methods.

UNIT 3 AIRPORT PLANNING 9

Air transport characteristics-airport classification- airport planning: objectives, components, layout characteristics, and socio-economic characteristics of the Catchment area, criteria for airport site selection and ICAO stipulations, Typical airport layouts, Parking and circulation area.

UNIT 4 AIRPORT DESIGN 9

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

UNIT 5 HARBOUR ENGINEERING 9

Harbor, Port, Satellite Port, Docks, Waves and Tides - Classification, Location– Harbor Layout – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage– Wave action on Coastal Structures and Coastal Regulation Zone, 2011.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee, 2012.
2. Satish Chandra and Agarwal M.M, "Railway Engineering", 2nd Edition, Oxford University Press, New Delhi, 2013.

REFERENCES:

1. Rangwala, "Railway,Airport and Harbour Engineering", Charotar Publishing House, 2013.
2. Oza.H.P. and Oza.G.H., “A course in Docks & Harbour Engineering”. Charotar Publishing Co., 2013
3. Mundrey J.S. “A course in Railway Track Engineering”. Tata McGraw Hill, 2007.
4. Srinivasan R. Harbour, “Dock and Tunnel Engineering", 26th Edition 2013.

e-RESOURCES:

1. http://nptel.ac.in/courses/105107123/Transportation Engineering II, Prof. Rajat Rastogi, IIT Roorkee.
2. https://books.google.co.in/books?isbn=0071614788/ Handbook of Transportation Engineering Volume II, Myer Kutz , McGraw Hill Professional.

21CEE53 **INFRASTRUCTURE PLANNING AND DESIGN**

L	T	P	C
3	0	0	3

PREAMBLE:

To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation, sustainable development of infrastructure

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

1. Explain the basic concepts related to Infrastructure Projects
2. Discuss the role of private sector in infrastructure growth.
3. Describe the strategies for successful Infrastructure Project implementation.
4. Develop Infrastructure modeling and Life Cycle Analysis Techniques.
5. Explain Sustainable development of Infrastructure

UNIT 1 AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE 9

Introduction to Infrastructure, an overview of the Power Sector in India - An Overview of the Water Supply and Sanitation Sector in India, Road, Rail, Air and Port Transportation Sectors in India, Telecommunications Sector in India, Urban Infrastructure in India, Rural Infrastructure in India and an Introduction to Special Economic Zones -Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle - an overview of Infrastructure Project Finance.

UNIT 2 PRIVATE INVOLVEMENT IN INFRASTRUCTURE 9

A Historical Overview of Infrastructure Privatization - The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization - Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.

UNIT 3 CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION 9

Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks - The Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure - Challenges in Construction and Maintenance of Infrastructure.

UNIT 4 STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION 9

Risk Management Framework for Infrastructure Projects - Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts - Introduction to Fair Process and Negotiation -Negotiating with multiple Stakeholders on Infrastructure Projects.

UNIT 5 SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE 9

Information Technology and Systems for Successful Infrastructure Management, - Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Grigg, Neil, Infrastructure engineering and management, Wiley, (1988).
2. Haas, Hudson, Zaniewski, Modern Pavement Management, Krieger, Malabar, (1994).

REFERENCES:

1. 2014. Peter Hall, Cities of tomorrow: an intellectual history of urban planning and design since 1880, Wiley and sons, Hoboken, 2014
2. R. Aromar. Shelter in India- Sustainable Development Series, Stosius Inc, Advent Books Division, 1990
3. National Urban Transport Policy. Ministry of Urban Development. Govt. of India. New Delhi, 2014.

e-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106188/, "Infrastructure Planning and Management", Dr.Ashwin Mahalingam, IIT-Madras
2. https://nptel.ac.in/courses/105106115, "Introduction to Infrastructure", Prof. A. Veeraragavan, IIT Madras.

21CEE54 **URBAN TRANSPORTATION PLANNING**

L	T	P	C
3	0	0	3

PREAMBLE:

The main objective of this course is to understand and apply basic concepts and methods of urban transportation planning. Apprise about the methods of designing, conducting and administering surveys to provide the data required for transportation planning. The students will understand the process of developing an organized mathematical modeling approach to solve select urban transportation planning problem.

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

1. Apply basic concepts and methods of urban transportation planning.
2. Design, conduct and administer surveys to provide the data required for transportation planning.
3. Supervise the process of data collection about travel behavior and analyze the data for use in transport planning.
4. Develop and calibrate modal split, trip generation rates for specific types of land use developments.
5. Adopt the steps that are necessary to complete a long-term transportation plan.

UNIT 1 URBAN TRANSPORT PLANNING **9**

Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning. Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.

UNIT 2 DATA COLLECTION AND INVENTORIES: **9**

collection of data – Organization of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

UNIT 3 TRIP GENERATION **9**

UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution by Growth Factor – Problems

UNIT 4 TRIP DISTRIBUTION **9**

Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis. -Problems

UNIT 5 TRAFFIC ASSIGNMENT **9**

Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment. Numerical problems on Traffic Assignment. Introduction to land use planning models, land use and transportation interaction.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Hutchinson, B.G, 'Introduction to Urban System Planning', McGraw Hill.
2. Khisty C.J., 'Transportation Engineering – An Introduction' Prentice Hall.

REFERENCES:

1. Bruton M.J., 'Introduction to Transportation Planning', Hutchinson of London.
2. Mayer M and Miller E, 'Urban Transportation Planning: A decision oriented Approach', McGraw Hill.

21CEE55 **SMART CITIES**

L	T	P	C
3	0	0	3

PREAMBLE:

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

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

1. Understand the basics of Urbanisation and the role of smart cities.
2. Gain knowledge on implementation of smart physical infrastructure.
3. Understand the role of smart planning for sustainable development.
4. Comprehend the knowledge of Technologies in Smart City planning.
5. Reviewing the case studies of smart city projects.

UNIT 1 INTRODUCTION **9**

Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission.

UNIT 2 SMART PHYSICAL INFRASTRUCTURE **9**

Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects.

UNIT 3 SUSTAINABILITY AND SMART PLANNING **9**

Relationship Between Sustainability and Smart planning - Place making project guidelinesSurveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services;

UNIT 4 APPLICATION OF TECHNOLOGIES IN SMART CITIES **9**

Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities.

UNIT 5 SMART CITIES PROJECT MANAGEMENT **9**

Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies.

TOTAL = 45 PERIODS

REFERENCES:

1. P Sharma , "Sustainable Smart cities in India, Challenges and Future Perspectives", Springer Link, 2017
2. Sameer Sharma,"Smart Cities Unbounded- Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018.
3. Binti Singh, ManojParmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory? Routledge India,2019

e-RESOURCES:

1. https://smartcities.gov.in/guidelines#block-habikon-content
2. https://smartnet.niua.org/learn/library

21CEE56 **TRANSPORTATION PLANNING PROCESS**

L	T	P	C
3	0	0	3

PREAMBLE:

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

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

1. Understand the principles of the transportation planning process and methods of data collection
2. Acquainted with the trip production, trip attraction models and calibration
3. Acquainted with the trip production, trip attraction models and calibration.
4. Able to understand trip distribution models and its application
5. Gain knowledge on the mode choice behaviour and mode split models.

UNIT 1 TRANSPORTATION PLANNING PROCESS 9

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

UNIT 2 TRIP GENERATION STAGE 9

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

UNIT 3 TRIP DISTRIBUTION STAGE 9

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

UNIT 4 MODAL SPLIT STAGE 9

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

UNIT 5 TRAFFIC ASSIGNMENT STAGE 9

Meaning and objective; General principles; Assignment Techniques- all-or-nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Mode-wise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019
2. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2009.

REFERENCES:

1. J D Ortuzar and L G Willumnsen. Modeling Transport. John Wiley and Sons, New York, 2011
2. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ce74/

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21CEE57 **INTELLIGENT TRANSPORT SYSTEM**

L	T	P	C
3	0	0	3

PREAMBLE:

To learn the fundamentals of ITS. · To study the ITS functional areas and have an overview of ITS implementation in developing countries

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

1. Understand the fundamentals of ITS and its benefits.
2. Gain knowledge on data collection using sensors and its applications.
3. Acquainted with the knowledge of ITS in Traffic Management
4. Application of ITS in-Transportation Planning
5. Able to gain knowledge on application of ITS in Logistics

UNIT 1 INTRODUCTION TO ITS **9**

Fundamentals of ITS: Definition of ITS, Challenges in ITS Development-Purpose of ITS Deployment-Benefits of ITS-Overview of application of ITS in Transportation Planning

UNIT 2 DATA COLLECTION THROUGH ITS **9**

Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)

UNIT 3 ITS IN TRAFFIC MANAGEMENT **9**

ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections

UNIT 4 ITS IN TRANSPORTATION PLANNING **9**

ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations – public transportation applications- Weight –in Motion

UNIT 5 ITS APPLICATION IN LOGISTICS **9**

Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics - E commerce

TOTAL = 45 PERIODS

TEXT BOOKS:

1. R. Srinivasa Kumar,"Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022.
2. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001

REFERENCES:

1. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992.
2. TurbanE.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998.
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles

e-RESOURCES:

1. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html
2. https://archive.nptel.ac.in/courses/105/101/105101008/

21CEE61 **CONCRETE TECHNOLOGY**

L	T	P	C
3	0	0	3

PREAMBLE:

This course deals about the properties of raw materials to make the concrete. It helps to provide the behaviour of concrete a t its fresh and hardened state. It deals with the concrete mix design and understands special concrete and their uses.

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

1. Identify and explain the characteristics of basic ingredients and properties of concrete.
2. Apply the effect of the admixtures on proportion and workability of concrete.
3. Design the concrete mix using BIS code.
4. Distinguish the properties of fresh and hardened concrete.
5. Justify the significance of special concretes viz., Light weight, fibre reinforced, polymer, self-compacting concrete.

UNIT 1 CONSTITUENT MATERIALS 9

Aggregates - Classification - Mechanical properties and tests as per BIS Grading requirements - Cement – Chemical composition and Properties - Tests on cement - IS Specifications – Water - Quality of water for use in concrete.

UNIT 2 CHEMICAL AND MINERAL ADMIXTURES 9

Accelerators - Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag (GGBS) and Metakaolin - Their effects on concrete properties (fresh and hardened state).

UNIT 3 PROPORTIONING OF CONCRETE MIX 9

Concept of Mix design - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Conventional Mix - BIS Method of Mix Design.- Examples

UNIT 4 FRESH AND HARDENED PROPERTIES OF CONCRETE 9

Workability - Tests for workability of concrete - Slump Test and Compacting factor Test - Segregation and Bleeding - Properties of Hardened concrete - Determination of Compressive and Flexural strength as per BIS - Stress-strain curve for concrete - Determination of Young‘s Modulus.

UNIT 5 SPECIAL CONCRETES 9

Light weight concretes - High strength concrete - Fibre reinforced concrete - Ferrocement - Ready mix concrete - SIMCON and SIFCON - Shotcrete - Polymer concrete - High performance concrete- Geopolymer Concrete - Self compacting concrete - Nano concrete - Smart concrete.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. M.S.Shetty, ―Concrete Technology‖, 8th Edition, Chand Publication, 2019.
2. A.M.Neville, J.J.Brookes, ―Concrete Technology‖, 5th Edition, Pearson Education, 2009.

REFERENCES:

1. A.R. Shanta Kumar, ―Concrete Technology‖, 1st Edition, Oxford University Press, New Delhi, 2010.
2. M.L. Gambhir, ―Concrete Technology‖, 3rd Edition, Tata Mc-Graw hill Publishers, New Delhi, 2013.
3. A.M. Neville, ―Properties of Concrete‖ , 2nd Edition, Pearson Education, 2012.
4. N. Krishna Raju, ―Design of Concrete Mixes‖, 2nd Edition, CBS Publishers and distributors, 2007.
5. IS10262:2019, Concrete mix design proportioning - Guidelines, Bureau of Indian Standard, New Delhi, 2019.

e-RESOURCES:

1. http://nptel.ac.in/courses/105102012/, ―Concrete Technology‖, Dr. B. Bhattacharjee, IIT Delhi
2. https://nptel.ac.in/courses/105/106/105106176/# , : Advanced Concrete technology‖, Dr Manu santhanam, IIT Madras .
3. http://theconstructor.org/concrete/.

21CEE62 **GROUND IMPROVEMENT TECHNIQUES**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart knowledge on dewatering, drainage and application of ground improvement techniques.

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

1. Identify and explain the dewatering techniques.
2. Explain the compaction and consolidation techniques to increase the density of soil.
3. Analyse the carrying capacity of stone columns, lime piles and nailing.
4. Design the earth reinforcement through geosynthetics and application.
5. Discuss the types and basic requirements of grouting techniques.

UNIT 1 DEWATERING **9**

Introduction - Scope and necessity of ground Improvement in Geotechnical Engineering - Ground Water lowering by well points, deep wells, vacuumand electro- osmotic methods. Stabilization by thermal and freezing techniques - Applications.

UNIT 2 COMPACTION AND SAND DRAINS **9**

In-situ compaction of granular and cohesive soils - Shallow and Deep compaction methods – Sand piles - factors influencing compaction. Blasting and dynamic consolidation - Preloading with sand grains - Theories of sand drain - relative merits of various methods.

UNIT 3 STONE COLUMN, LIME PILES AND SOIL NAILING **9**

Stone column, lime piles - Functions - methods of installation - design, estimation of load carrying capacity and settlement - Root piles and soil nailing - methods of installation - Design and applications - Soil liquefaction mitigation methods.

UNIT 4 EARTH REINFORCEMENT **9**

Earth reinforcement - Principles and basic mechanismof reinforced earth, simple design: Synthetic and natural fiber based geotextiles and their applications - Filtration, drainage, separation, erosion control - Electro-Chemical stabilization - Stabilization with cement, lime.

UNIT 5 GROUTING **9**

Grouting - Types of grout - Suspension and solution grouts - Basic requirements of grout. Grouting equipment – injection methods - Jet grouting - grout monitoring.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Dr. P. Purushothama Raj, ―Ground Improvement Techniques (PB)‖, Laksmi Publications (P) Ltd, 2005.
2. Jewell, R.A., ―Soil Reinforcement with Geotextiles‖, CIRIA, London, 1996.

REFERENCES:

1. Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., ―Ground Improvement and Geo synthetics‖, Geotechnical special publication No.207, Geo Institute, ASCE, 2010.
2. Koerner, R.M., ―Designing with Geosynthetics‖, Third Edition, Prentice Hall 1997.
3. Das, B.M., ―Principles of Foundation Engineering‖, Fourth Edition, PWS Publishing, 1999.

e-RESOURCES:

1. http://nptel.ac.in/courses/105108075, ―Ground Improvement Techniques‖, Dr. G.L. SivakumarBabu, Civil Engineering, IISc Bangalore.
2. http://nptel.ac.in/courses/105104034, ―Ground Improvement Techniques‖, Dr. NiharRanjanPatra, Civil Engineering, IIT Kanpur.

21CEE63 **REMOTE SENSING**

L	T	P	C
3	0	0	3

PREAMBLE:

To introduce the concepts of remote sensing processes and its components and to expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation.

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

1. understand the concepts and laws related to remote sensing
2. understand the interaction of electromagnetic radiation with atmoshphere and earth material
3. acquire knowledge about satellite orbits and different types of satellites
4. understand the different types of remote sensors
5. gain knowledge about the concepts of interpretation of satellite imagery

UNIT 1 REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive - Radiation Quantities

UNIT 2 EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction ofradiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT 3 ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton‘s law of gravitation - Gravitational field and potential - Escape velocity - Kepler‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit.

UNIT 4 SENSING TECHNIQUES 9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites

UNIT 5 DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, AmericanSociety of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995

21CEE64 **STRUCTURAL GEOLOGY**

L	T	P	C
3	0	0	3

PREAMBLE:

The main objective of this course is to familiarize the students on the role and importance of geology in civil engineering, apart from learning the techniques of surface and subsurface investigations using geological, geophysical and geomechanical methods

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

1. Knowing the internal structure of earth and its relation to earthquakes. Landforms created by various geological agents and their importance in civil engineering.
2. Getting knowledge on various minerals and rocks that can be used as construction materials and road aggregates. In addition, testing the suitability of rocks for foundation purposes.
3. Studying various geological structures and their impact in engineering constructions. Further, learning the geomechanical properties of rocks and their significance in engineering projects.
4. Gaining knowledge on the role of geological mapping, remote sensing and geophysics for surface and subsurface investigations. In addition, students will also gain knowledge on borehole logging techniques and their applications in civil engineering.
5. Applying geological knowledge for designing and constructing major civil engineering structures, and also mitigating various geological hazards such as earthquakes, landslides and tsunamis.

UNIT 1 PHYSICAL GEOLOGY AND GEOMORPHOLOGY 9

Significance of Geology in Civil Engineering; Internal structure of the Earth; Weathering: types, engineering classification of weathered rocks and relevance to Civil Engineering; Fluvial, Marine, Glacial and Aeolian landforms and their importance in Civil Engineering; Plate tectonics and its relevance to earthquakes; Groundwater: types of aquifers, origin, movement and role of groundwater in Civil Engineering constructions.

UNIT 2 MINERALOGY AND PETROLOGY 9

Physical and Chemical properties of common rock forming minerals: Quartz family, Feldspar family, Mica (Muscovite, Biotite & Vermiculite), Pyroxene (Augite & Hypersthene), Amphibole (Hornblende), Calcite, Gypsum and Clay minerals and their significance. Formation of Igneous, Metamorphic and Sedimentary rocks; Description of important rocks: Granite, Syenite, Dolerite, Basalt, Quartzite, Slate, Schist, Gneiss, Marble, Sandstone, Limestone, Shale and Conglomerate. Engineering properties of rocks: field and laboratory tests.

UNIT 3 STRUCTURAL GEOLOGY AND ROCK MECHANICS 9

Attitudes of beds: Strike and Dip measurements and their relevance to civil engineering; Different types of folds, faults, joints and fractures in rocks and their significance in civil engineering constructions; Geomechanical properties of rocks: Rock Quality Designation (RQD), Rock Mass Rating (RMR) and Geological Strength Index (GSI) and their importance in various civil engineering projects.

UNIT 4 GEOPROSPECTING 9

Geological mapping techniques; Remote Sensing: Fundamentals and its role in geological mapping; Geophysical methods for subsurface investigations: Electrical, Seismic & Ground Penetrating Radar (GPR); Subsurface logging and their importance in civil engineering projects.

UNIT 5 GEOLOGICAL CONSIDERATIONS AND GEOHAZARDS 9

Geological conditions necessary for designing and construction of important structures: Dams, Reservoirs, Tunnels, Road cuttings and Coastal protection; Landslides: Causes and mitigation; Earthquakes & Tsunamis: Causes and mitigation; Case studies for the above topics.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Parbin Singh, "A Textbook of Engineering and General Geology", S. K. Kataria and Sons, 2021.
2. Chenna Kesavulu, N. "Textbook of Engineering Geology", Macmillan India Ltd., 2018.

REFERENCES:

1. Legget, "Geology and Engineering", McGraw Hill Book company, 1998 Blyth, "Geology for Engineers", ELBS 1995.
2. Krynine and Judd, "Principals of Engineering Geology and Geotechnics" Tata McGraw Hill, New Delhi, 2018.

21CEE65 **RAINWATER HARVESTING**

L	T	P	C
3	0	0	3

PREAMBLE:

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

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

1. On completion of the course, the student is expected to be able to
2. Understand the need and importance of water conservation through global and Indian practices of rainwater harvesting
3. Understand and apply the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials
4. Understand the various types of rainwater harvesting methods and apply it on the field
5. Design the various RWH structures to harvest the rainwater in surface and subsurface

UNIT 1 BASICS OF RWH **9**

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

UNIT 2 HYDROLOGY AND GROUND WATER **9**

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

UNIT 3 METHODS OF RAINWATER HARVESTING **9**

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

UNIT 4 DESIGN OF RAINWATER HARVESTING STRUCTURES **9**

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

UNIT 5 MANAGEMENT OF RWH AND CASE STUDIES **9**

Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems – Maintenance of RWH structures - Modernisation of RWH system - Case studies on best practice of RWH in urban - Success stories of Contemporary practices of RWH in India.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. H.M Raghunath “Ground Water” 3rd Edition, New Age International 2007.
2. Jayarami Reddy.P, (2005) “A Text book of Hydrology” Firewall media Publication.

REFERENCES:

1. Proceedings of UNHABITAT Blue water series “Rainwater harvesting and utilization”, Book 2 beneficiaries and capacity builders.
2. Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water Resources Central Ground Water Board Faridabad,2003.

21CEE66 **CLIMATE CHANGE ADAPTATION AND MITIGATION**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students

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

1. an insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change
2. understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties
3. ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy
4. Gain in-depth knowledge on climate models
5. Post process the model outputs for climate impact assessment, know about adaptation strategies

UNIT 1 INTRODUCTION **9**

Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle

UNIT 2 ELEMENTS RELATED TO CLIMATE CHANGE **9**

Greenhouse gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

UNIT 3 IMPACTS OF CLIMATE CHANGE **9**

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

UNIT 4 MITIGATING CLIMATE CHANGE **9**

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

UNIT 5 ALTERNATE FUELS AND RENEWABLE ENERGY **9**

Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Ruddiman W.F, freeman W.H. and Company, "Earth‟s Climate Past and Future", 2001
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

REFERENCES:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah "Climate Change and Biodiversity", TERI Publishers, 2005

e-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/nou21_ge37
2. https://archive.nptel.ac.in/courses/127/106/127106004/

21CEE67 **STEEL-CONCRETE COMPOSITE STRUCTURES**

L	T	P	C
3	0	0	3

PREAMBLE:

To develop an understanding of the effect composite action and assess governing limit states for composite elements.

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

1. Describe the effect of composite action has on structural component behavior.
2. Describe and assess governing limit states for composite beam.
3. Describe and assess governing limit states for composite slab.
4. Describe and assess governing limit states for composite column.
5. Study and evaluate the case studies related to steel concrete composite constructions of building.

UNIT 1 INTRODUCTION TO COMPOSITE ACTION 9

Introduce composite beams, including shear studs – Determine the location of a beam's neutral axis/axes depending on the level of composite action. Calculate shear stud strength and understand strength modifiers - deflection of composite beams.

UNIT 2 DESIGN OF COMPOSITE BEAM 9

Introduce composite beams, including shear studs – Determine the location of a beam's neutral axis/axes depending on the level of composite action. Calculate shear stud strength and understand strength modifiers - deflection of composite beams.

UNIT 3 DESIGN OF COMPOSITE COLUMN 9

Types of Composite columns – design of encased columns – design of in-filled columns – axial, uniaxial and bi-axially loaded columns.

UNIT 4 DESIGN OF COMPOSITE SLAB 9

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span.

UNIT 5 CASE STUDIES 9

Case studies on steel concrete composite construction in buildings - seismic behaviour of composite structures.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Revised Edition, Pergamon press, Oxford, 2000.

REFERENCES:

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

e-RESOURCES:

1. http://www.nptel.ac.in/courses/105106112/ ―Design of steel structures‖, Prof. S.R.Satish Kumar and Prof. A.R.Santha Kumar, Indian Institute of Technology, Madras.
2. http://www.steel-insdag.org/TM_Contents.asp ―Prof. Rangachari Narayanan, Retired Head of the Education and Publications Division, The Steel Construction Institute, England‖, Institute for Steel Development & Growth, Kolkata.

21CEO01 **CIVIL AND INFRASTRUTURE ENGINEERING**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the basic knowledge on Civil Engineering materials, Sub-structure, Construction practices, Surveying, Highway and Environmental concepts.

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

1. Explain the building components, materials and sub-structures.
2. Discuss the highway classification and cross-sectional elements.
3. Discuss the various construction practices in the field.
4. Demonstrate the knowledge on surveying through linear, angular measurement, Total station and GPS.
5. Identify and explain water distribution and sewerage system.

UNIT 1 CIVIL ENGINEERING MATERIALS AND SUB -STRUCTURE 9

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

Sub –Structure: Foundations - Types of Foundation – Shallow and Deep foundation - Requirement of good foundations – Compaction and consolidation – Slope stability.

UNIT 2 CONSTRUCTION PRACTICES 9

Masonry - Brick masonry – Bonds in Brickwork – Stone masonry – Classification of stone masonry – Scaffoldings - Types of Scaffoldings - Box Jacking - Pipe Jacking – Sinking cofferdam - Launching girders - Bridge decks - Erection of light weight components.

UNIT 3 SURVEYING 9

Objects – Types – Classification – Principles – Measurements of distances – Chain surveying – Measurement of Angles using theodolite – Leveling – Rise and Fall method – Height of instrument method - Determination of areas – Illustrative examples – Contour - Total Station – GPS.

UNIT 4 HIGHWAY ENGINEERING 9

Significance of highway plans - Classification of highways: NH, SH, MDR and ODR - Highway Cross sectional elements: Road Margins, Right of way, Carriage way, Shoulder, Formation width, Median or Separator, Camber and Kerbs.

UNIT 5 ENVIRONMENTAL CONCEPTS 9

Components of water distribution system – Sources of water – Surface and Ground water – Characteristics of water – Physical and Chemical characteristics – Water quality standards - Sewerage system – Comparison of slow and rapid sand filter.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", 2nd Edition, Tata McGraw Hill Publishing Co., New Delhi, 2010.
2. Venugopal K., Prabhu Raja V. and Sreekanjana G., "Basic Civil and Mechanical Engineering",3rd Edition, Anuradha Publishers, Kumbakonam, 2010. Reprint 2016

REFERENCES:

1. RamamruthamS.,"Basic Civil Engineering", 3rd Edition, DhanpatRai Publishing Company,2013.
2. Varghese, P.C. "Building Construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2016.
3. Bindra.S.P and Arora.S.P, "Building Construction", DhanpatRai Publication Pvt, Ltd, 2010.

e-RESOURCES:

1. http://nptel.ac.in/courses/105102088/, "Building Materials and Construction", Prof. Dr. B. Bhattacharjee, IIT Delhi.
2. https://www.britannica.com/technology/building-construction.

21CEO02 ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT

L	T	P	C
3	0	0	3

PREAMBLE:

This course is useful to provide students an knowledge on water, air and noise pollution, solid and hazardous waste management systems.

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

1. Explain the basic concepts of water pollution and its effects on human health and ecosystem.
2. Discuss the major air pollutants, their sources, chemical transformations in the atmosphere.
3. Identify the various noise pollution control strategies.
4. Discuss the sources and effects of improper disposal of solid waste on health and environment.
5. Explain the possible treatment method of hazardous waste.

UNIT 1 WATER POLLUTION 9

Water Pollution: Sources and types of water pollution-Causes and effects of water pollution-Control measures of water pollution-Physical and chemical characteristics of water-Water quality standards as per BIS-Water pollution legislation.

UNIT 2 AIR POLLUTION 9

Air Pollution: Components of atmosphere-Sources and types of air pollutants- Effect of air pollution on human and environment- Formation and effects of smog-Preventive measures and control strategies of air pollution-Air pollution controlling equipment's-Air pollution laws.

UNIT 3 NOISE POLLUTION 9

Noise Pollution: Sources and types of noise pollution- Effects of noise pollution on environment, human health and animal - Control measures of noise pollution– Noise reducing techniques- Permissible noise limits-Legislation.

UNIT 4 SOLID WASTE MANAGEMENT 9

Sources and types of solid wastes – Waste generation rates-factors affecting generation of solid wastes-Methods of sampling and characterization- Effects of improper disposal of solid wastes – public health -environment- Elements of solid waste management - Public awareness- Role of NGOs.

UNIT 5 HAZARDOUS WASTE MANAGEMENT 9

Definition of hazardous wastes-Sources and characteristics-Hazardous waste regulations-Minimization of hazardous waste-Handling and storage of hazardous waste-Physical and chemical treatment of hazardous waste-Hazardous waste control measures.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Dr.Suresh K.Dhameja, Environmental Science and Engineering, S.K.Kataria & Sons, New Delhi, 2017.
2. Anjaneyulu, D., Air Pollution and Control Technologies‖, Allied Publishers, Mumbai, 2014

REFERENCES:

1. T.V.Ramachandra, "Management of Municipal Solid Waste", Capital Publishing Company, New Delhi,2017.
2. PE Cunniff , "Environmental Noise Pollution" , McGraw Hill, New York, 1987.

e-RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104099/"Environmental Air Pollution",Prof. MukeshSharma,IIT Kanpur.
2. http://nptel.ac.in/courses/120108005, "Municipal Solid Waste Management", Prof. T.V. Ramachandra, IISc Bangalore.

21CEO03 **DISASTER MANAGEMENT AND MITIGATION**

L	T	P	C
3	0	0	3

PREAMBLE:

This course is useful to provide students an exposure to disasters- their significance and types and knowledge on relationship between vulnerability- disasters- disaster prevention and risk reduction.

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

1. Identify and explain the types of disasters- causes and their impact on environment and society.
2. Identify and explain the vulnerability and various methods of risk reduction measures as well as mitigation.
3. Draw the hazard and vulnerability profile of India- Scenarios in the Indian context- Disaster damage assessment and management.
4. Apply the remote sensing and GIS techniques for predicting the natural disasters.
5. Discuss how to work on recovery & rehabilitation due to disasters.

UNIT 1 INTRODUCTION TO DISASTERS 9

Definition: Disaster- Hazard - Vulnerability - Resilience - Risks - Disasters: Types of disasters - Earthquake- Landslide - Flood - Drought - Fire - Classification - Causes - Impacts including social - economic - political - environmental – health - psychosocial - Differential impacts - in terms of caste - class - gender - age - location - disability - Global trends in disasters: urban disasters - pandemics - complex emergencies - Climate change - Dos and Don'ts during various types of Disasters.

UNIT 2 APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases - Culture of safety – prevention - mitigation and preparedness community based DRR – Structural - nonstructural measures - Roles and responsibilities of – community - Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs) - States - Centre - and other stakeholders - Institutional Processess and Framework at State and Central Level - State Disaster Management Authority(SDMA) - Early Warning System - Advisories from Appropriate Agencies.

UNIT 3 INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities - differential impacts - impact of Development projects such as dams- embankments - changes in Land-use.- Climate Change Adaptation - IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge- appropriate technology and local resources.

UNIT 4 DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India - Components of Disaster Relief: Water – Food - Sanitation- Shelter - Health -Waste Management - Institutional arrangements (Mitigation- Response and Preparedness - Disaster Management Act and Policy - Other related policies – plans - programmes and legislation - Role of GIS and Information Technology Components in Preparedness - Risk Assessment - Response and Recovery Phases of Disaster - Disaster Damage Assessment.

UNIT 5 DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies - Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies - Drought Assessment: Case Studies - Coastal Flooding: Storm Surge Assessment - Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies - Man Made disasters: Case Studies - Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Singhal J.P, "Disaster Management", Laxmi Publications- 2010.
2. Singh R, Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications 2017.
3. Gupta Anil, K.Sreeja, S. Nair, "Environmental Knowledge for Disaster Risk Management- NIDM", New Delhi- 2011

REFERENCES:

1. Govt. of India: Disaster Management Act - Government of India- New Delhi- 2005.
2. Government of India- National Disaster Management Policy- 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

e-RESOURCES:

1. http://www.ndmindia.nic.in- "National Disaster Management Authority"- Government of India.
2. http://ndma.gov.in/en/, "National Disaster Management Authority"- Government of India.

21CEO04 **BUILDING SERVICES**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart the various aspects involved in Civil Engineering practice and the principles of ventilation, electrical, mechanical, fire systems, air conditioning facilities and green building..

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

1. Acquire knowledge in lighting and ventilation systems.
2. Acquire knowledge in electrical components.
3. Synchronize with installation of mechanical accessories in buildings.
4. Discuss about the fire protection techniques.
5. Discuss about green building applications to the new constructions

UNIT 1 LIGHTING AND VENTILATION 9

Definitions - Objective and uses of services - Applications of services for different types building considering - Classification of building services - Types of services and selection of services - Natural and artificial lighting - Principles and factors - Necessity of Ventilation - Types of ventilation - Natural and Mechanical, Factors to be considered in the design of Ventilation.

UNIT 2 ELECTRICAL SYSTEMS IN BUILDINGS 9

Technical terms and symbols for electrical installations - Accessories of wiring - Types of insulation - Electrical layout for residence, small work shop, show room, school building and high rise building.

UNIT 3 MECHANICAL SERVICES IN BUILDINGS 9

Lift: Definition, Types of Lifts - Design Considerations – Location – Sizes - Component parts.

Elevators & Escalators: Different types of elevators and Escalators - Freight elevators - Passenger elevators - Hospital elevators - Uses of different types of elevators Escalators.

Air Conditioning: Principles - Temperature Control - Air Velocity Control - Humidity Control -Air Distribution system – Types of air conditioners – HVAC system.

UNIT 4 FIRE PROTECTION 9

Introduction - Causes of fire and Effects of fire - General Requirements of Fire Resisting Building as per IS: 1642:1989 and NBC 2005 - Characteristics of Fire Resisting Materials - Maximum Travel Distance - Fire Fighting Installations for Horizontal Exit - Roof Exit / Fire Lifts, External Stairs.

UNIT 5 MISCELLANEOUS SERVICES AND GREEN BUILDINGS PROVISIONS 9

Plan for Rain Water Harvesting in the New Buildings - Concept and components of green building - Components of Grey Water System – Management of Grey Water System and Distribution Pattern - Solar Power System.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Mantri Sandeep, "The A to Z of Practical building construction and its management", Satya Prakashan, New Delhi, 2020.
2. R. Udaykumar, "A text book on Building Services", Eswar Press, Chennai.

REFERENCES:

1. Krunal Thanki, "Building Services: Part-1", Kindle Edition, 2019.
2. SP 7: 2016, "National Building Code of India" 2016..

e-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/102/105102176/, "Fire protection services and maintenance management of building", Prof. B.Bhattacharjee, IIT Delhi.
2. https://archive.nptel.ac.in/courses/105/102/105102195/, "Sustainable materials and green building", Prof. B.Bhattacharjee, IIT Delhi.

21CEM51 **SUSTAINABLE INFRASTRUCTURE DEVELOPMENT**

L	T	P	C
3	0	0	3

PREAMBLE:

To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

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

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

UNIT 1 SUSTAINABLE DEVELOPMENT GOALS 9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT 2 SUSTAINABLE INFRASTRUCTURE PLANNING 9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT 3 SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES 9

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT 4 SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT 5 SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS 9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

REFERENCES:

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.

e-RESOURCES:

1. https://www.unep.org/explore-topics/green-economy/what-we-do/sustainable-infrastructureinvestment.
2. https://www.iisd.org/savi/

21CEM52	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

PREAMBLE:

To educate the students about the issues of sustainability in agro ecosystems, introduce the concepts and principles of agro ecology as applied to the design and management of sustainable agricultural systems for a changing world.

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

1. Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
2. Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
3. Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
4. Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
5. Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agro ecosystem

UNIT 1 AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9

Ecosystem definition - Biotic *Vs.* abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT 2 SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT 3 WATER MANAGEMENT 9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT 4 ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT 5 EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020

REFERENCES:

1. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
2. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016

e-RESOURCES:

1. https://link.springer.com/book/10.1007/978-981-13-6830-1
2. https://www.worldwildlife.org/industries/sustainable-agriculture

21CEM53 **SUSTAINABLE BIO MATERIALS**

L	T	P	C
3	0	0	3

PREAMBLE:

The primary objective of this course is to impart knowledge of biomaterials and their properties The Fundamentals aspects and significance of bioceramics, Biopolymers & bionanomaterials and their applications

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

1. gain familiarity with Biomaterials and they will understand their importance.
2. get an overview of different biopolymers and their properties
3. gain knowledge on some of the important Bioceramics and Biocomposite materials
4. gain knowledge on metals as biomaterials
5. gains knowledge on the importance of nanobiomaterials in biomedical applications.

UNIT 1 INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants-Impact and Future of Biomaterials

UNIT 2 BIO POLYMERS 9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions-Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT 3 BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)-Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT 4 METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT 5 NANOBIOMATERIALS 9

Metallic nanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics-BioNEMs -Biosensor- Bioimaging/Molecular Imaging- challenges and future perspective.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

REFERENCES:

1. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018
2. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.

e-RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6273984/
2. https://sustainablebiomaterials.org/

21CEM54 **MATERIALS FOR ENERGY SUSTAINABILITY**

L	T	P	C
3	0	0	3

PREAMBLE:

The primary objective of this course is to familiarize the students about the challenges and demands of energy sustainability. To provide fundamental knowledge about electrochemical devices and the materials used and various types of fuel cell. The students will learn about novel materials and their usage in photovoltaic application a nd basic principles of various types Supercapacitors and the materials used.

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

1. acquire knowledge about energy sustainability.
2. understand the principles of different electrochemical devices.
3. learn about the working of fuel cells and their application.
4. will learn about various Photovoltaic applications and the materials used.
5. gain knowledge on different types of supercapacitors and the performance of various materials

UNIT 1 SUSTAINABLE ENERGY SOURCES **9**

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.

UNIT 2 ELECTROCHEMICAL DEVICES **9**

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT 3 FUEL CELLS **9**

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT 4 PHOTOVOLTAICS **9**

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT 5 SUPERCAPACITORS **9**

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)-Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.

REFERENCES:

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.

e-RESOURCES:

1. https://www.nature.com/collections/pwybcfjfhb
2. https://mse.stanford.edu/research-impact/research-overview/materials-sustainability

21CEM55	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

PREAMBLE:

To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability**.**

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

1. understand the principles of green engineering and technology
2. learn about pollution using hazardous chemicals and solvents
3. modify processes and products to make them green and safe.
4. design processes and products using green technology
5. understand advanced technology in green synthesis

UNIT 1 PRINCIPLES OF GREEN CHEMISTRY 9

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT 2 POLLUTION TYPES 9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT 3 GREEN REAGENTS AND GREEN SYNTHESIS 9

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT 4 DESIGNING GREEN PROCESSES 9

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT 5 GREEN NANOTECHNOLOGY 9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008
2. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.

REFERENCES:

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
2. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997

e-RESOURCES:

1. https://greenly.earth/en-us/blog/ecology-news/everything-you-need-to-know-about-green-technology-in-2022
2. https://unacademy.com/content/kerala-psc/study-material/science-technology/green-technology/

21CEM56	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

PREAMBLE:

To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity

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

1. explain basic concepts of environmental standards and monitoring.
2. explain ambient air quality and water quality standards;
3. explain the various instrumental methods and their principles for environmental monitoring
4. explain the significance of environmental standards in monitoring quality and sustainability of the environment.
5. explain the various ways of raising environmental awareness among the people.
6. explain the standard research methods that are used worldwide for monitoring the environment.

UNIT 1 ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT 2 MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT 3 ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT 4 ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification-exposure assessment- dose-response assessment; risk characterization

UNIT 5 AUTOMATED DATA ACQUISITION AND PROCESSING 9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES:

1. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
2. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ch33/
2. https://unece.org/environmental-monitoring

21CEM57	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

PREAMBLE:

To create awareness on the energy scenario of India with respect to world and also to understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation

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

1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

UNIT 1 ENERGY SCENARIO **9**

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT 2 ENERGY AND ENVIRONMENT **9**

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT 3 SUSTAINABLE DEVELOPMENT **9**

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.

UNIT 4 RENEWABLE ENERGY TECHNOLOGY **9**

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT 5 ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT **9**

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012

REFERENCES:

1. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
2. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016

e-RESOURCES:

1. https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/067/42067676.pdf
2. https://www.seforall.org/universal-integrated-energy-plans

21CEM58	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

PREAMBLE:

To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation and also to create awareness on energy audit and its impacts

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

1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

UNIT 1 ENERGY AND ENVIRONMENT 9

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT 2 ENERGY AUDITING 9

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT 3 ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT 4 ENERGY CONSERVTION IN ELECTRICAL UTILITIES 9

Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT 5 SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,

TOTAL = 45 PERIODS

TEXT BOOKS:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022

REFERENCES:

1. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022

e-RESOURCES:

1. https://www.seforall.org/energy-efficiency-for-sustainable-development
2. https://www.sciencedirect.com/science/article/abs/pii/S0360544221026141