ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (UNIVERSITY DEPARTMENTS)

Campus: CEG Campus, Anna University

Department: CIVIL ENGINEERING

Programme: B.E. Civil Engineering

Regulations: 2023 (Revised 2024), with effect from the AY 2024 – 25 to all the students of UG Programme.

OVERVIEW OF CREDITS

Sem	PCC	PEC	ESC	HSMC	ETC	OEC	SDC	UC	SLC	Total
I	-	-	3	11	-	-	7	1	-	22
II	-	-	11	11	-	-	-	1	-	23
III	19	-	5	-	-	-	2	-	-	26
IV	21	-	-	-	-	-	2	3	-	26
V	9	6	1	-	-	3	3	3	-	25
VI	8	3	-	-	3	3	1	3	-	21
VII	7	9	-	-	3	-	1	-	1	21
VIII	-	-	-	-	-	-	8	-	-	8
Total	64	18	20	22	6	6	24	11	1	172
% of Category	37.4	10.5	11.1	12.9	3.5	3.5	14.0	6.4	0.6	100

CATEGORY OF COURSES

PCC – Professional Core Course
PEC – Professional Elective Course
ETC – Emerging Technology Course
OEC – Open Elective Course
SLC – Self Learning Course
ESC – Engineering Science Course
HSMC – Humanities Science and Management Course
SDC – Skill Development Course
UC – University Course

For Honours & Minor Degree, please refer the Regulations 2023 (Revised 2024).

SEMESTER – I							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	EN23C01	Foundation English	LIT	2-0-2	4	3	HSMC
2	MA23C01	Matrices and Calculus	T	3-1-0	4	4	HSMC
3	CY23C01	Engineering Chemistry	LIT	3-0-2	5	4	HSMC
4	EE23C02	Fundamentals of Electrical and Electronics Engineering	LIT	3-0-0	3	3	ESC
5	ME23C01	Engineering Drawing and 3D Modelling	LIT	2-0-4	6	4	SDC
6	ME23C04	Makerspace	LIT	1-0-4	5	3	SDC
7	UC23H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	UC
8	-	NCC/NSS/NSO/YRC		0-0-2	2	-	UC
9	-	Audit Course–I	-	-	-	-	UC
TOTAL CREDITS						**22**	

*** TCP –** Total Contact Period(s)

#**TYPE OF COURSE**

LIT – Laboratory Integrated Theory

T – Theory

L – Laboratory Course

IPW – Internship cum Project Work

PW – Project Work

CDP – Capstone Design Project

SEMESTER – II							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	EN23C02	Professional Communication	LIT	2-0-2	4	3	HSMC
2	MA23C02	Ordinary Differential Equations and Transform Techniques	T	3-1-0	4	4	HSMC
3	PH23C01	Engineering Physics	LIT	3-0-2	5	4	HSMC
4	CS23C04	Programming in C	LIT	2-0-4	6	4	ESC
5	GY23C01	Engineering Geology	LIT	2-0-2	4	3	ESC
6	ME23C03	Engineering Mechanics	T	3-1-0	4	4	ESC
7	UC23H02	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	UC
TOTAL CREDITS						**23**	

SEMESTER – III							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23301	Strength of Materials - I	LIT	3-0-2	5	4	PCC
2	CE23302	Construction Engineering	LIT	3-0-2	5	4	PCC
3	CE23303	Fluid Mechanics	LIT	3-0-2	5	4	PCC
4	CE23304	Railways, Airports and Harbour Engineering	T	3-0-0	3	3	PCC
5	CE23305	Water Supply Engineering	LIT	3-0-2	5	4	PCC
6	CE23C04	Principles of Surveying	LIT	3-0-4	7	5	ESC
7	-	Audit Course–II	-	-	-	-	UC
	-	Skill Development Course I	-	-	-	2	SDC
TOTAL CREDITS						**26**	

SEMESTER – IV							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23401	Strength of Materials - II	T	3-0-0	3	3	PCC
2	CE23402	Soil Mechanics	LIT	3-0-4	7	5	PCC
3	CE23403	Applied Hydraulic Engineering	LIT	3-0-2	5	4	PCC
4	CE23404	Highway Engineering	LIT	3-0-4	7	5	PCC
5	CE23405	Waste Water Engineering	LIT	3-0-2	5	4	PCC
6	CE23U01	Standards – Civil Engineering	T	1-0-0	1	1	UC
7	UC23U01	Universal Human Values	LIT	1-0-2	3	2	UC
8	-	Skill Development Course - II	L	2-0-0	2	2	SDC
TOTAL CREDITS						**26**	

#NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER – V (PREFERENCE FOR FOREIGN EXCHANGE)							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23501	Structural Analysis - I	T	3-0-0	3	3	PCC
2	CE23502	Design of Reinforced Cement Concrete Structures	T	3-0-0	3	3	PCC
3	CE23503	Foundation Engineering	T	3-0-0	3	3	PCC
4	-	Professional Elective I	T	3-0-0	3	3	PEC
5	-	Professional Elective II	T	3-0-0	3	3	PEC
6	CE23504	Environmental Engineering Drawing	L	0-0-2	2	1	ESC
7	-	Open Elective - I	T	3-0-0	3	3	OEC
8	CE23U02	Perspectives of Sustainable Development	T	2-0-2	4	3	-
9	-	Skill Development Course - III	T	2-0-0	2	2	-
10	-	Industry Oriented Course I	-	-	-	1	SDC
TOTAL CREDITS						**25**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23D01	Capstone Design Project – Level I Course on relevant field of product development through physical, online (or) hybrid mode, as approved by Mentor assigned	CDP	3-0-0	3	3	SDC
2	-	Skill Development (Design & Fabrication of components)	CDP	0-0-6	6	3	SDC
(OR)							
1.	-	Honours Elective – I	T	3-0-0	3	3	PEC
2.	-	Honours Elective – II	T	3-0-0	3	3	PEC
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	-	Minor Elective – I	T	3-0-0	3	3	PCC
2.	-	Minor Elective – II	T	3-0-0	3	3	PCC

SEMESTER – VI (PREFERENCE FOR FOREIGN EXCHANGE)							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23601	Structural Analysis - II	T	3-0-0	3	3	PCC
2	CE23602	Design of Steel Structures	T	3-0-0	3	3	PCC
3	CE23603	Building and Structural Drawing	L	0-0-4	4	2	PCC
4	-	Professional Elective III	T	3-0-0	3	3	PEC
5	-	Open Elective - II	T	3-0-0	3	3	OEC
6	UC23E01	Engineering Entrepreneurship Development	LIT	2-0-2	4	3	UC
7	-	Industry Oriented Course III	-	-	-	1	SDC
8	-	Emerging Technology Course I	T	3-0-0	3	3	ETC
			TOTAL CREDITS			**21**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23D02	Capstone Design Project – Level II Course on relevant field of product development through physical, online (or) hybrid mode, as approved by Mentor assigned	CDP	3-0-0	3	3	SDC
2	-	Skill Development (Proof of Concept including prototyping)	CDP	0-0-6	6	3	SDC
(OR)							
1.	-	Honours Elective – III	T	3-0-0	3	3	PEC
2.	-	Honours Elective – IV	T	3-0-0	3	3	PEC
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	-	Minor Elective – III	T	3-0-0	3	3	
2.	-	Minor Elective – IV	T	3-0-0	3	3	

SEMESTER – VII							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1	CE23701	Irrigation Engineering	LIT	3-0-2	5	4	PCC
2	CE23702	Estimation, Costing and Valuation Engineering	T	3-0-0	3	3	PCC
3	-	Professional Elective IV	T	3-0-0	3	3	PEC
4	-	Professional Elective V	T	3-0-0	3	3	PEC
5	-	Professional Elective VI	T	3-0-0	3	3	PEC
6	-	Industry Oriented Course III	-	-	-	1	SDC
7	-	Emerging Technology Course II	T	3-0-0	3	3	ETC
8	CE23L01	Self-Learning Course$	-	-	-	1	SLC
			TOTAL CREDITS			**21**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	CE23D03	Capstone Design Project – Level III Capstone Design (Skill Development) – First phase in the development of product	CDP	0-0-12	12	6	SDC
(OR)							
1.	–	Honours Elective – V	T	3-0-0	3	3	PEC
2.	-	Honours Elective – VI	T	3-0-0	3	3	PEC
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	–	Minor Elective – V	T	3-0-0	3	3	PEC
2.	-	Minor Elective – VI	T	3-0-0	3	3	PEC

SEMESTER – VIII							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	CE23801	Project Work / Internship cum Project Work	PW/IPW	0-0-16	16	8	SDC
					TOTAL CREDITS	**8**	

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 172

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	EN23C01	Foundation English	2	0	2	4	3
2.	MA23C01	Matrices and Calculus	3	1	0	4	4
3.	PH23C01	Engineering Physics	3	0	2	5	4
4.	EN23C02	Professional Communication	2	0	2	4	3
5.	MA23C02	Ordinary Differential Equations and Transform Techniques	3	1	0	4	4
6.	CY23C01	Engineering Chemistry	3	0	2	5	4
						Total	**22**

ENGINEERING SCIENCES COURSES (ESC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	EE23C02	Fundamentals of Electrical and Electronics Engineering	3	0	0	3	3
2.	CS23C04	Programming in C	2	0	4	6	4
3.	GY23C01	Engineering Geology	2	0	2	4	3
4.	ME23C03	Engineering Mechanics (Department Course)	3	1	0	4	4
5.	CE23C04	Principles of Surveying	3	0	4	7	5
6.	CE23506	Environmental Engineering Drawing	0	0	2	2	1
						Total	**19**

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23301	Strength of Materials - I	3	0	2	5	4
2.	CE23302	Construction Engineering	3	0	2	5	4
3.	CE23303	Fluid Mechanics	3	0	2	5	4
4.	CE23304	Railways, Airports and Harbour Engineering	3	0	0	3	3
5.	CE23305	Water Supply Engineering	3	0	2	5	4
6.	CE23401	Strength of Materials - II	3	0	0	3	3
7.	CE23402	Soil Mechanics	3	0	4	7	5
8.	CE23403	Applied Hydraulic Engineering	3	0	2	5	4
9.	CE23404	Highway Engineering	3	0	4	7	5
10.	CE23405	Waste Water Engineering	3	0	2	5	4
11.	CE23501	Structural Analysis - I	3	0	0	3	3
12.	CE23502	Design of Reinforced Cement Concrete Structures	3	0	0	3	3
13.	CE23503	Foundation Engineering	3	0	0	3	3

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
14.	CE23601	Structural Analysis - II	3	0	0	3	3
15.	CE23602	Design of Steel Structures	3	0	0	3	3
16.	CE23603	Building and Structural Drawing	0	0	4	4	2
17.	CE23701	Irrigation Engineering	3	0	2	5	4
18.	CE23702	Estimation, Costing and Valuation Engineering	3	0	0	3	3
						Total	**64**

PROFESSIONAL ELECTIVE COURSES (PEC): VERTICALS / ELECTIVES FOR HONOURS DEGREE

Vertical I (Structures)	Vertical II (Construction Techniques and practices)	Vertical III (Geotechnical)	Vertical IV (Geo-Informatics)	Vertical V (Transportation Infrastructure)	Vertical VI (Environment)	Vertical VII (Water Resources)	Vertical VIII (Ocean Engineering)
Concrete Technology	Construction Equipment and Machinery	Geo-Environmental Engineering	Environmental Geoinformatics	Traffic Engineering and Management	Climate Change Adaptation and Mitigation	Hydrology and Water Resources Engineering	Oceanography
Prefabricated Structures	Construction Project Management through Lean Concepts	Ground Improvement Techniques	Transportation Geomatics	Transportation Planning Process	Air Pollution Control Engineering	Integrated Water Resources Management	Ocean Wave Dynamics
Prestressed Concrete Structures	Construction Quality and Safety	Soil Dynamics and Machine Foundations	Geomatics for Hydrology and Water Resources	Urban and Regional Planning	Environmental Impact Assessment	Groundwater Engineering	Sea Surveying and Monitoring
Structural Retrofit and Rehabilitation	Advanced Construction Techniques	Rock Mechanics	Geomatics for Disaster and Risk Mitigation	Transport and Environment	Industrial Wastewater Management	Watershed Management	Port and Harbour Engineering
Dynamics and Earthquake Resistant Structures	Energy Efficient Buildings	Earth and Earth Retaining Structures	Geomatics for Agriculture and Forestry	Smart Cities	Solid and Hazardous Waste Management	Rainwater Harvesting	Coastal Engineering
Finite Element Method in Civil Engineering	Digitalized Construction Lab	Pile Foundations	Geomatics for Ocean and Coastal Applications	Intelligent Transportation Systems	Environmental Legislations in India	Water Resources and Global Climate Change	Offshore Technology

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered from Semesters V to 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, more than one course is permitted from the same row, provided each course is enrolled in different semester.

The registration of courses for B.E./B.Tech (Hons) 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 (Hons) also. For more details on B.E./B.Tech (Hons) refer to the Regulations 2023, Clause 4.11.

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL I: STRUCTURES

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23001	Concrete Technology	3	0	0	3	3
2.	CE23002	Prefabricated Structures	3	0	0	3	3
3.	CE23003	Prestressed Concrete Structures	3	0	0	3	3
4.	CE23004	Structural Retrofit and Rehabilitation	3	0	0	3	3
5.	CE23005	Dynamics and Earthquake Resistant Structures	3	0	0	3	3
6.	CE23006	Finite Element Method in Civil Engineering	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL II: CONSTRUCTION TECHNIQUES AND PRACTICES

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23007	Construction Equipment and Machinery	3	0	0	3	3
2.	CE23008	Construction Project Management Through Lean Concepts	3	0	0	3	3
3.	CE23009	Construction Quality and Safety	3	0	0	3	3
4.	CE23010	Advanced Construction Techniques	3	0	0	3	3
5.	ME23C07	Energy Efficient Buildings	3	0	0	3	3
6.	CE23011	Digitalized Construction Lab	0	0	6	6	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL III: GEOTECHNICAL

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23012	Geo-Environmental Engineering	3	0	0	3	3
2.	CE23013	Ground Improvement Techniques	3	0	0	3	3
3.	CE23014	Soil Dynamics and Machine Foundations	3	0	0	3	3
4.	CE23015	Rock Mechanics	3	0	0	3	3
5.	CE23016	Earth and Earth Retaining Structures	3	0	0	3	3
6.	CE23017	Pile Foundations	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL IV: GEO-INFORMATICS

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	GI23C02	Environmental Geoinformatics	3	0	0	3	3
2.	CE23018	Transportation Geomatics	3	0	0	3	3
3.	GI23C03	Geomatics for Hydrology and Water Resources	3	0	0	3	3
4.	GI23C04	Geomatics for Disaster and Risk Mitigation	3	0	0	3	3
5.	CE23019	Geomatics for Agriculture and Forestry	3	0	0	3	3
6.	GI23C05	Geomatics for Ocean and Coastal Applications	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL V: TRANSPORTATION INFRASTRUCTURE

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23020	Traffic Engineering and Management	3	0	0	3	3
2.	CE23021	Transportation Planning	3	0	0	3	3
3.	CE23022	Urban and Regional Planning	3	0	0	3	3
4.	CE23023	Transport and Environment	3	0	0	3	3
5.	CE23024	Smart Cities	3	0	0	3	3
6.	CE23025	Intelligent Transportation Systems	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL VI: ENVIRONMENT

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23026	Climate Change Adaptation and Mitigation	3	0	0	3	3
2.	CE23027	Air Pollution Control Engineering	3	0	0	3	3
3.	CE23028	Environmental Impact Assessment	3	0	0	3	3
4.	CE23029	Industrial Wastewater Management	3	0	0	3	3
5.	CE23030	Solid and Hazardous Waste Management	3	0	0	3	3
6.	CE23031	Environmental Legislations in India	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL VII: WATER RESOURCES

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK				CREDITS

			L	T	P	TOTAL	
1.	CE23032	Hydrology and Water Resources Engineering	3	0	0	3	3
2.	CE23033	Integrated Water Resources Management	3	0	0	3	3
3.	CE23034	Groundwater Engineering	3	0	0	3	3
4.	CE23035	Watershed Management	3	0	0	3	3
5.	CE23036	Rainwater Harvesting	3	0	0	3	3
6.	CE23037	Water Resources and Global Climate Change	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL VIII: OCEAN ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CE23038	Oceanography	3	0	0	3	3
2.	CE23039	Ocean Wave Dynamics	3	0	0	3	3
3.	CE23040	Sea Surveying and Monitoring	3	0	0	3	3
4.	CE23041	Port and Harbour Engineering	3	0	0	3	3
5.	CE23042	Coastal Engineering	3	0	0	3	3
6.	CE23043	Offshore Technology	3	0	0	3	3

OPEN ELECTIVE COURSES

(Offered by the Department of Civil Engineering to other Departments)

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS
				L-T-P	TCP*	
1	CE23901	Sustainable Engineering	T	3-0-0	3	3
2	CE23902	Waste to Energy	T	3-0-0	3	3
3	CE23903	Hydrology	T	3-0-0	3	3

SKILL DEVELOPMENT COURSES (SDC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	ME23C01	Engineering Drawing & 3D Modelling	2	0	4	6	4
2.	ME23C04	Makerspace	1	0	4	5	3

3.		Skill Development Course - I	2	0	0	2	2
4.		Skill Development Course - II	2	0	0	2	2
5.		Skill Development Course - III	2	0	0	2	2
6.		Industry Oriented Course - I					1
7.		Industry Oriented Course - II					1
8.		Industry Oriented Course - III					1
9.		Project Work / Semester long Internship	0	0	16	16	8
						TOTAL	**24**

LIST OF OFFERED INDUSTRY ORIENTED COURSES

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.		Building Information Modeling in Construction					1
2.		Metro Rail Transportation Design & Construction					1
3.		Opportunities in Housing Sector					1
4.		Renewable Energy in Civil Engineering					1

Note: Contact period per course = 15 hours

UNIVERSITY COURSES (UC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	UC23H01	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	1
2.	UC23P01	NCC / NSS / NSO / YRC	0	0	2	2	0
3.	-	Audit Course – I	2	0	0	2	0
4.	UC23H02	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	1
5.	-	Audit Course – II	2	0	0	2	0
6.	CE23U01	Standards – Civil Engineering	1	0	0	1	1
7.	UC23U01	Universal Human Values	1	0	2	3	2
8.	CE23U02	Perspectives of Sustainable Development	2	0	2	4	3
9.	UC23E01	Engineering Entrepreneurship Development	2	0	2	4	3
						TOTAL	**11**

EMERGING TECHNOLOGY COURSES (ETC)

S. No.	Course Code	Course Name	Course Type#	Periods / Week		Credits
				L-T-P	TCP*	
1	CE23E01	Artificial Intelligence in Civil Engineering	T	3-0-0	3	3
2	CE23E02	Unmanned Aerial System (UAS) For Large Scale Mapping	T	3-0-0	3	3
3	CE23E03	Robotics in Construction	T	3-0-0	3	3
4.						

MINOR PROGRAMME ON CONSTRUCTION ENGINEERING

Offered by Department of Civil Engineering for other Branch students

S. No.	Course Code	Course Name	Course Type#	Periods / Week		Credits
				L-T-P	TCP*	
1	CE23044	Construction Engineering Practices	T	3-0-0	3	3
2	CE23045	Surveying Techniques	T	3-0-0	3	3
3	CE23046	Geotechnical Engineering	T	3-0-0	3	3
4	CE23047	Transportation Engineering	T	3-0-0	3	3
5	CE23048	Water and Wastewater Engineering	T	3-0-0	3	3
6	CE23049	Estimation, Costing and Valuation	T	3-0-0	3	3

MINOR PROGRAMME ON ENVIRONMENTAL ENGINEERING

Offered by Department of Civil Engineering for other Branch students

S. No.	Course Code	Course Name	Course Type#	Periods / Week		Credits
				L-T-P	TCP*	
1	CE23050	Environmental Chemistry and Microbiology	T	3-0-0	3	3
2	CE23051	Environmental Economics	T	3-0-0	3	3
3	CE23052	Water and Wastewater Engineering	T	3-0-0	3	3
4	CE23053	Environmental Impact Assessment	T	3-0-0	3	3
5	CE23054	Air and Noise Pollution Control	T	3-0-0	3	3
6	CE23055	Waste management for circular economy	T	3-0-0	3	3

EN23C01 **FOUNDATION ENGLISH** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To develop students' foundational skills in reading, writing, grammar and vocabulary to enable them to understand and produce various forms of communication.
- To enhance students' proficiency in reading comprehension, narrative and comparative writing.
- To comprehend and analyse descriptive texts and visual images
- To articulate similarities and differences in oral and written forms.
- To improve students' proficiency in reading and writing formal letters and emails.

UNIT I BASICS OF COMMUNICATION **6**

Reading - Telephone message, bio-note; Writing – Personal profile; Grammar – Simple present tense, Present continuous tense, wh-questions, indirect questions; Vocabulary – Word formation (Prefix and Suffix).

LAB ACTIVITY: **6**

Listening – Telephone conversation; Speaking Self-introduction; Telephone conversation – Video conferencing etiquette

UNIT II NARRATION **6**

Reading – Comprehension strategies - Newspaper Report, An excerpt from an autobiography; Writing – Narrative Paragraph writing (Event, personal experience etc.); Grammar – Subject-verb agreement, Simple past, Past continuous Tenses; Vocabulary – One-word substitution

LAB ACTIVITY: **6**

Listening – Travel podcast; Speaking – Narrating and sharing personal experiences through a podcast

UNIT III DESCRIPTION **6**

Reading – A tourist brochure, Travel blogs, descriptive article/excerpt from literature, visual images; Writing –Descriptive Paragraph writing, Grammar – Future tense, Perfect tenses, Preposition; Vocabulary – Descriptive vocabulary

LAB ACTIVITY: **6**

Listening – Railway / Airport Announcements, Travel Vlogs; Speaking – Describing a place or picture description

UNIT IV COMPARE AND CONTRAST **6**

Reading – Reading and comparing different product specifications - Writing – Compare and Contrast Essay, Coherence and cohesion; Grammar – Degrees of Comparison; Vocabulary – Transition words (relevant to compare and contrast)

LAB ACTIVITY: **6**

Listening – Product reviews, Speaking – Product comparison based on product reviews - similarities and differences

UNIT V EXPRESSION OF VIEWS **6**

Reading – Formal letters, Letters to Editor ; Writing – Letter writing/ Email writing (Enquiry / Permission, Letter to Editor); Grammar – Compound nouns, Vocabulary – Synonyms, Antonyms

LAB ACTIVITY: **6**

Listening – Short speeches; Speaking – Making short presentations (JAM)

TOTAL: 60 PERIODS

TEACHING METHODOLOGY

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab assessment

Listening

Speaking

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- Use appropriate grammar and vocabulary to read different types of text and converse appropriately.
- Write coherent and engaging descriptive and comparative essay writing.
- Comprehend and interpret different kinds of texts and audio visual materials
- Critically evaluate reviews and articulate similarities and differences
- Write formal letters and emails using appropriate language structure and format

TEXT BOOKS:

1. “English for Engineers and Technologists” Volume I by Orient Blackswan, 2022

2. “English for Science & Technology - I” by Cambridge University Press, 2023

REFERENCES

1. “Interchange” by Jack C.Richards, Fifth Edition, Cambridge University Press, 2017.

2. “English for Academic Correspondence and Socializing” by Adrian Wallwork, Springer, 2011.

3. “The Study Skills Handbook” by Stella Cortrell, Red Globe Press, 2019

4. www.uefap.com

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										√		√
CO2										√		
CO3										√		√
CO4										√		
CO5										√		√

MA23C01	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques in solving practical problems.
- To familiarize the student with functions of several variables.
- To solve integrals by using Beta and Gamma functions.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To acquaint the students with the concepts of vector calculus which naturally arise in many engineering problems.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors- Cayley-Hamilton theorem (excluding proof) – Diagonalization of matrices - Reduction of Quadratic form to canonical form by using orthogonal transformation - Nature of a Quadratic form.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9+3

Limit, continuity, partial derivatives – Homogeneous functions and Euler's theorem - Total derivative – Differentiation of implicit functions – Jacobians -Taylor's formula for two variables - Errors and approximations – Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.

UNIT III INTEGRAL CALCULUS 9+3

Improper integrals of the first and second kind and their convergence – Differentiation under integrals - Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions-Properties – Evaluation of single integrals by using Beta and Gamma functions..

UNIT IV MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals-
Evaluation of double and triple integrals by using Beta and Gamma functions.

UNIT V VECTOR CALCULUS 9+3

Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields - Line integrals over a plane curve - Surface integrals – Area of a curved surface – Volume Integral - Green's theorem, Stoke's and Gauss divergence theorems (without proofs)– Verification and applications in evaluating line, surface and volume integrals.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students wherever applicable from the content of the course.

General engineering applications / branch specific applications from the content of each units wherever possible will be introduced to students.

Suggested Laboratory based exercises / assignments / assessments :

Matrices

1. Finding eigenvalues and eigenvectors
2. Verification of Cayley-Hamilton theorem
3. Eigenvalues and Eigenvectors of similar matrices
4. Eigenvalues and Eigenvectors of a symmetric matrix
5. Finding the powers of a matrix
6. Quadratic forms

Functions of Several Variables

1. Plotting of curves and surfaces
2. Symbolic computation of partial and total derivatives of functions

Integral Calculus

1. Evaluation of beta and gamma functions
2. Computation of error function and its complement

Multiple Integrals

1. Plotting of 3D surfaces in Cartesian and Polar forms

Vector Calculus

1. Computation of Directional derivatives
2. Computation of normal and tangent to the given surface

OUTCOMES:

CO 1 :Use the matrix algebra methods for solving practical problems.
CO 2 :Use differential calculus ideas on several variable functions.
CO 3 :Apply different methods of integration in solving practical problems by using Beta and Gamma functions.
CO 4 :Apply multiple integral ideas in solving areas and volumes problems.
CO 5 :Apply the concept of vectors in solving practical problems.

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir "'Thomas' Calculus", Pearson Education., New Delhi, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, New Delhi, 2020.
3. James Stewart, Daniel K Clegg & Saleem Watson "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2023.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO5 :	3	3	2	3	1	2	1	1	1	1	1	3

PH23C01 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E/B.Tech Programmes) **3 0 2 4**

COURSE OBJECTIVES

- To familiarize with crystal structure, bonding and crystal growth.
- To impart knowledge on Mechanics of Materials.
- To impart knowledge of oscillations, sound and Thermal Physics
- To facilitate understanding of optics and its applications, different types of Lasers and fiber optics.
- To introduce the basics of Quantum Mechanics and its importance.

UNIT I CRYSTAL PHYSICS **9+6**

Crystal Bonding – Ionic – covalent – metallic and van der Walls's/ molecular bonding. Crystal systems - unit cell, Brava lattices, Miller indices - Crystal structures - atomic packing density of BCC, FCC and HCP structures. NaCl, Diamon Graphite, Graphene, Zincblende and Wurtzite structures - crystal imperfections- point defects - edge and screw dislocation – grain boundaries. Crystal Growth – Czocharalski method – vapor phase epitaxy – Molecular beam epitaxy- Introductio to X-Ray Diffractometer.

1. Determination of Lattice parameters for crystal systems.
2. Crystal Growth – Slow Evaporation method
3. Crystal Growth Sol – Gel Method

UNIT II MECHANICS OF MATERIALS **9+6**

Rigid Body – Centre of mass – Rotational Energy - Moment of inertia (M.I)- Moment of Inertia for uniform objects wi various geometrical shapes. Elasticity –Hooke's law - Poisson's ratio - stress-strain diagram for ductile and brittle materia – uses- Bending of beams – Cantilever - Simply supported beams - uniform and non-uniform bending - Young's modulu determination - I shaped girders –Twisting couple – Shafts. Viscosity – Viscous drag – Surface Tension.

4. Non-uniform bending -Determination of Young's modulus of the material of the beam.
5. Uniform bending -Determination of Young's modulus of the material of the beam
6. Viscosity – Determination of Viscosity of liquids.

UNIT III OSCILLATIONS, SOUND AND THERMAL PHYSICS **9+6**

Simple harmonic motion - Torsional pendulum –- Damped oscillations –Shock Absorber -Forced oscillations and Resonanc –Applications of resonance.- Waves and Energy Transport –Sound waves – Intensity level – Standing Waves - Doppl effect and its applications - Speed of blood flow. Ultrasound – applications - Echolocation and Medical Imaging. Therm Expansion – Expansion joints – Bimetallic strip – Seebeck effect – thermocouple -Heat Transfer Rate – Conduction Convection and Radiation.

7. Torsional pendulum-Determination of rigidity modulus of wire and moment of inertia of the disc
8. Melde's string experiment - Standing waves.
9. Ultrasonic interferometer – determination of sound velocity and liquids compressibility

UNIT IV OPTICS AND LASERS **9+6**

Interference - Thin film interference - Air wedge- Applications -Interferometers–Michelson Interferometer -– Diffraction - C as diffraction grating – Diffraction by crystals -Polarization - polarizers — Laser – characteristics – Spontaneous an Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG laser, CO_2 laser, Semiconducto laser - Industrial and medical applications - Optical Fibers – Total internal reflection – Numerical aperture and acceptanc angle – Fiber optic communication – Fiber sensors – Fiber lasers.

10. Laser - Determination of the width of the groove of the compact disc using laser.
    Laser Parameters
    Determination of the wavelength of the laser using grating

11. Air wedge -Determination of the thickness of a thin sheet/wire
12. Optical fibre - Determination of Numerical Aperture and acceptance angle
-Determination of bending loss of fibre.
13. Michelson Interferometer (Demonstration)

UNIT V QUANTUM MECHANICS 9+6

Black body radiation (Qualitative) – Planck's hypothesis – Einstein's theory of Radiation - Matter waves–de Broglie hypothes - Electron microscope – Uncertainty Principle – The Schrodinger Wave equation (time-independent and time-dependent) Meaning and Physical significance of wave function - Normalization - Particle in an infinite potential well-particle in a thre dimensional box - Degenerate energy states - Barrier penetration and quantum tunneling - Tunneling microscope.

14. Photoelectric effect – Determination of Planck's constant.
15. Black Body Radiation (Demonstration)
16. Electron Microscope (Demonstration)

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the significance of crystal structure and bonding. Learn to grow crystals.
CO2: Obtain knowledge on important mechanical and thermal properties of materials and determine them through experiments.
CO3: Conceptualize and visualize the oscillations and sound.
CO4: Grasp optical phenomenon and their applications in real life.
CO5: Appreciate and evaluate the quantum phenomenon.
CO6 Develop skill set to solve engineering problems and design experiments.

TEXT BOOKS:

1. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2013.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics. John Wiley & Sons, 10th Edition, 201
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students, Springer-Verlag, 2012.
4. Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson, College Physics, McGraw-Hill Highe Education, 2012.

REFERENCES:

1. R. Wolfson, Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D. Kleppner and R. Kolenkow. An Introduction to Mechanics, McGraw Hill Education, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1							
CO2	3	2	1	1								
CO3	3	2	1	1								
CO4	3	2	1	1	1							
CO5	3	2	1	1	1							
CO6	3	2	1	2								

EE23C02	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

UNIT I BASIC ELECTRICAL CIRCUITS 9

DC Circuits: Sources, Ohm's Law - Kirchhoff's Laws – Solution of DC circuits with Independent sources only (Steady state)

AC Circuits: AC Fundamentals: Waveforms, Average value, RMS Value, Impedance, Instantaneous Power, Real Power, Reactive Power and Apparent Power, Power Factor – Steady State Analysis of RL, RC and RLC Circuits.

UNIT II AC and DC MACHINES 9

Magnetic Circuits fundamentals – DC Machines: Construction, Working Principle, Types and Applications of DC Generator and Motor, EMF and Torque equation.

AC Machines: Construction, Working and Applications of Transformer, Three phase Alternator, Synchronous motor, Single and Three Phase Induction Motor and BLDC motor.

UNIT III ANALOG AND DIGITAL ELECTRONICS 9

Operation and Characteristics of electronic devices: PN Junction Diodes, Zener Diode, BJT, JFET and MOSFET– Operational Amplifiers (OPAMPs) : Characteristics and basic application circuits-555 timer IC based astable and monostable multivibrator.

Basic switching circuits – Gates and Flip-Flops-Sample and hold circuit- R-2R ladder type DAC-Successive approximation based ADC.

UNIT IV SENSORS AND TRANSDUCERS 9

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, piezo electric crystals, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional Elements of an Instrument, Error analysis; Operating Principle - Moving Coil and Moving Iron Instruments, Power Measurement, Energy Meter, Instrument Transformers - CT and PT, Multimeter- DSO - Block Diagram Approach.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Compute the electric circuit parameters for simple problems.

CO 2: Explain the working principles and characteristics of electrical machines, electronic devices and measuring instruments.

CO3: Identify general applications of electrical machines, electronic devices and measuring instruments.

CO 4: Analyze the basic electrical and electronic circuits.

CO 5: Explain the types and operating principles of sensors and transducers.

TEXT BOOKS:

1. Kothari DP and Nagrath IJ, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, Second Editions, 2020.
2. Bhattacharya SK, “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition,2017
3. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.

REFERENCES:

1. Rajendra Prasad ‘Fundamentals of Electrical Engineering’, Third Edition, Prentice Hall of India, 2014.
2. Sanjeev Sharma ‘Basics of Electrical Engineering’ Wiley, 2019.
3. Doebelin, E.O., Measurements Systems – Application and Design’, McGraw Hill Publishing Co, 2019.
4. D.Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New age international Publishers, 2018.
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010

Mapping of COs with POs and PSOs															
COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO/PO & PSO Average	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															

ME23C01	ENGINEERING DRAWING AND 3D MODELLING	L	T	P	C
		2	0	4	4

COURSE OBJECTIVES

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

1. Understand and use the engineering curves in engineering applications and projection techniques to construct conic curves, points and lines.
2. Develop skills in projecting surfaces and solids and create 2D models using CAD software.
3. Develop skills in 3D projection and 3D modeling of simple parts manually as well as using CAD software.
4. Understand and apply sectioning techniques to solids and assemble components.
5. Develop skills in lateral surface development and sheet metal design.

INTRODUCTION

Manual drawing tools (Mini Drafter, Set Squares, Protractor, Compass, and different grades of pencil). **'**BIS' specifications and rules of Engineering Drawing – Arrows (2H thin line body, HB Filled head and L:W = 3:1 ratio), lettering (Digital fonts, font sizes pertaining to usage and representation), types of line and their syntax (Drawing based – Continuous thin & thick, dashed, dashed dotted and Application based – extension, dimensioning, construction, projection, reference, axis, section, hatching, and break lines), scaling (up, down and equal), and dimensioning. Placing and positioning the 'A3' size drawing sheet over the drawing table. Principal planes and projection, Division of line and circle in to equal parts, and construction of polygons

UNIT I: ENGINEERING CURVES, PROJECTION OF POINTS AND LINES 6+12

Construction of conic curves with their tangent and normal – ellipse, parabola, and hyperbola by eccentricity method

Construction of special curves with their tangent and normal – cycloid, epicycloid, and involute

Projection of points and I angle projection of lines inclined to both principal planes by rotating line method and trapezoidal rule – marking their traces.

Lab exercises: Study exercise – Introduction to Sketching (or) Drawing, and modification tools in CAD software (AutoCAD, CREO, CATIA, Solid Works, Inventor, Fusion 360)

Activities based learning: Identification of the curves used in the application given in the flash card, demonstration of the instantaneous centre of rotation of governors with respect to angle of inclination of the arms of the governors

UNIT II PROJECTION OF SURFACES & SOLIDS, AND 2D MODELING 6+12

Projection of surfaces inclined to both the principal planes – polygonal, trapezoidal, rhomboidal and circular

Projection of solids – prisms, pyramids, and axisymmetric solids when the axis inclined to both the principal planes – freely hanging – contour resting condition on either of the planes by rotating object method

Lab exercises: Construction of basic sketches – lines, circle, polygon, spline curves, coils, along with dimensioning. Familiarizing with geometric constraints and their types

Activities based learning: Making the solids using cardboards, shadow mapping and contour drawing at different orientation of the solids using torches,

UNIT III 3D PROJECTION OF SOLIDS AND 3D MODELING OF SIMPLE PARTS 6+12

Free hand sketching – I & III angle projections of engineering parts and components

Isometric projection of combination of solids – prisms, pyramids, axisymmetric solids, frustum

Perspective projection of prisms, pyramids and axisymmetric solids by visual ray method

Lab exercises: 3D Modeling and 2D drafting of machine parts

Activities based learning: Flipped classroom for Free hand sketching, Jig saw activity for Isometric projection, arts and crafts for perspective view

UNIT IV SECTION OF SOLIDS AND SECTIONED DRAFTING OF ASSEMBLED COMPONENTS 6+12

Section of simple and hollow solids – prisms, pyramids and axisymmetric solids, solids with holes/ slots when the section plane perpendicular to one principal plane and inclined to other principal plane ('On the axis' and 'from the axis' conditions)

Application based – section of beams (I, T, L, and C), section of pipe bracket, wood joints, composite walls, shells, flange of a coupling and other similar applications

Lab exercises: Assembly of parts with respect to engineering constraints, and sectioned drafting of assembled components

Activities based learning: Making of mitered joint in wood, sectioning the beams in different angles of orientation and identifying the true shape

UNIT V LATERAL SURFACE DEVELOPMENT AND SHEET METAL DESIGN 6+12

Lateral surface development of sectioned solids when the section plane perpendicular to VP and inclined to HP.

Application based – construction of funnel, chimney, dish antenna, door latch, trays, AC vents, lamp shade, commercial packaging boxes with respect to sectioning conditions and other similar applications

Lab exercises: Sheet metal design and drafting, drafting of coils, springs and screw threads

Activities based learning: Fabrication of funnels, chimney, lamp shade, boxes using card boards, ply woods, acrylics

Total: 90 Hours

Note: Activities based learning should not be covered in the regular class hours. It should be given as assignments to the group of maximum 3 members

Question pattern suggestion: Part – A (Either or type) (5 × 16 = 80) & Part – B (Compulsory) (1 × 20 = 20)

COURSE OUTCOME:-

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

CO1: Construct and identify different types of conic curves and special curves, and project the points and lines pertaining to engineering applications
CO2: Project and visualize surfaces and solids in different orientations and utilize the CAD tools for designing.
CO3: Create and draft accurate 3D models and 2D drawings of machine parts manually as well as using CAD softwares
CO4: Determine the true shape of a sectioned solid and draft the assemble parts accordingly
CO5: Develop lateral surfaces of sectioned solids and design sheet metal components

TEXTBOOKS:

1. Engineering Drawing" by N S Parthasarathy and Vela Murali
2. Engineering Drawing and Graphics with Auto CAD" by Venugopal K

REFERENCE BOOKS:

1. "Basic Engineering Drawing: Mechanical Semester Pattern" by Mehta and Gupta
2. "Engineering Drawing" by Basant Agrawal and C M Agrawal
3. "Engineering Drawing With Auto CAD" by B V R Gupta
4. "Engineering Drawing" by P S Gill
5. "Engineering Drawing with an Introduction to AutoCAD" by Dhananjay Jolhe
6. "Engineering Drawing" by M B Shah
7. "Fundamentals of Engineering Drawing" by Imtiaz Hashmi
8. "Computer Aided Engineering Drawing" by S Trymbaka Murthy
9. "CAED : Computer Aided Engineering Drawing for I/II Semester BE/Btech Courses" by Reddy K B
10. "Computer-Aided Engineering Drawing" by Subrata Pal

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2		1				3	1		3	3	3	2
2	3	3	2		2				3	2		3	3	3	2
3	3	3	3	1	2				3	3		3	3	3	2
4	3	3	3	1	3				3	3		3	3	3	2
5	3	3	3	1	3				3	3		3	3	3	2

ME23C04	MAKERSPACE	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

1. To practice the usage of various tools towards assembly and dis-assembly of different items / equipment.
2. To make simple part / component using welding processes.
3. To train on the basic wiring practices of boards, machines, etc.
4. To provide a hands-on experience on the use of electronic components, equipment, sensors and actuators.
5. To expose to modern computer tools and advanced manufacturing / fabrication processes.

LIST OF ACTIVITIES **1L,4P**

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.

ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.

iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.

iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.

ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.

iii. Hands-on session of preparing base material & Joint groove for welding.

iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.

ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box,

iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.

iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.

ii. Dis-assembly and assembly of Computers.

iii. Hands-on session of Soldering Practices in a Printed Circuit Breaker.

iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.

v. Hands-on session of integration of sensors and actuators with a Microcontroller.

vi. Demonstration of Programmable Logic Control Circuit.

(E).Contemporary Systems

i. Demonstration of Solid Modelling of components.

ii. Demonstration of Assembly Modelling of components.

iii. Fabrication of simple components / parts using 3D Printers.

iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

TOTAL: 75 Periods (15 Lecture + 60 Practical)

COURSE OUTCOMES:

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

CO1: Assemble and dis-assemble various items / equipment.

CO2: Make simple parts using suitable welding processes.

CO3: Setup wiring of distribution boards, machines, etc.

CO4: Utilise the electronic components to fabricate a simple equipment, aided with sensors and actuators.

CO5: Take advantage of modern manufacturing practices.

REFERENCES:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th ed. (Indian edition), 2017.
5. Mazidi, Naimi, Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 1st edition 2013.

6. Visualization, Modeling, and Graphics for Engineering Design, D.K. Lieu, S.A. Sorby, Cengage Learning; 2nd edition.

UC23H01 **தமிழர் மரபு** **L T P C**
1 0 0 1

அலகு I **மொழி மற்றும் இலக்கியம்**: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: **3**

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

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்**: **3**

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

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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

UC23H01 **HERITAGE OF TAMILS** **L T P C**
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

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

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

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

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL : 15 PERIODS

REFERENCES:

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

NCC Credit Course Level 1*

UC23P01	(ARMY WING) NCC Credit Course Level - I	L T P C 2 0 0 2

NCC GENERAL **6**

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS **4**

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

PERSONALITY DEVELOPMENT **7**

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P02	**(NAVAL WING) NCC Credit Course Level – I**	**L T P C** **2 0 0 2**
NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P03	**(AIR FORCE WING) NCC Credit Course Level – I**	**L T P C** **2 0 0 2**
NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

EN23C02 PROFESSIONAL COMMUNICATION L T P C
2 0 2 3

COURSE OBJECTIVES:

- To read and comprehend different forms of official texts.
- To develop students' writing skills in professional context.
- To actively listen, read and understand written and oral communication in a professional context.
- To comprehend and analyse the visual content in authentic context.
- To write professional documents with clarity and precision

UNIT I CAUSE AND EFFECT 6

Reading – Newspaper articles on Social and Environmental issues; Writing – Instructions, Cause and effect essay; Grammar - Modal verbs; Vocabulary – Cause and effect, Idioms

LAB ACTIVITY: 6

Listening and Speaking – Listen to news reports and summarise in oral form.

UNIT II CLASSIFICATION 6

Reading – An article, social media posts and classifying based on the content; Writing – Definition, Note making, Note taking (Cornell notes etc.) and Summarising; Grammar – Connectives; Vocabulary – Phrasal verbs

LAB ACTIVITY: 6

Listening and speaking: Social interaction (Conversation including small talk)

UNIT III PROBLEM AND SOLUTION 6

Reading – Visual content (Tables/charts/graphs) for comprehension; Writing - Problem and Solution Essay; Grammar – If conditionals; Vocabulary – Sequential words.

LAB ACTIVITY: 6

Listening – Group discussion; Speaking – Participating in a group discussion

UNIT IV REPORT 6

Reading – Formal report on accidents (industrial/engineering); Writing – Industrial Accident report; Grammar – Active and passive voice, Direct and Indirect speech; Vocabulary – Numerical adjectives.

LAB ACTIVITY: 6

Listening / watching – Television documentary and discussing its content, purpose etc.

UNIT V JOB APPLICATION AND INTERVIEW 6

Reading - Job advertisement and company profile; Writing – Job application (cover letter and CV) Grammar – Mixed Tenses; Vocabulary – Collocations related to work environment

LAB ACTIVITY: 6

Listening – Job interview; Speaking – Mock interviews

TOTAL: 60 PERIODS

TEACHING METHODOLOGY

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab Assessment

Group discussion (Peer assessment)

Listening

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- To apply appropriate language structure and vocabulary to enhance both spoken and written communication in formal contexts.
- Comprehend different forms of official documents
- Write professional documents coherently and cohesively.
- Interpret verbal and graphic content in authentic context
- Analyse and evaluate verbal and audio visual materials.

TEXT BOOKS:

1. “English for Engineers and Technologists” Volume 2 by Orient Blackswan, 2022

2. “English for Science & Technology - II” by Cambridge University Press, 2023.

REFERENCES:

1. “Communicative English for Engineers and Professionals” by Bhatnagar Nitin, Pearson India, 2010.

2. ”Take Off – Technical English for Engineering” by David Morgan, Garnet Education, 2008. 3. “Advanced Communication Skills” by Mathew Richardson, Charlie Creative Lab, 2020.

4. www.uefap.com

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										√		√
CO2										√		√
CO3										√		√
CO4										√		√
CO5										√		√

MA23C02 ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVES:

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To make the students to understand the Laplace transforms techniques.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques in solving difference equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Homogeneous linear ordinary differential equations of second order -superposition principle - general solution- Particular integral - Operator method - Solution by variation of parameters - Method of undetermined coefficients - Homogeneous equations of Euler–Cauchy and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II LAPLACE TRANSFORMS 9+3

Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace transforms- Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.

UNIT III FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Computation of harmonics.

UNIT IV FOURIER TRANSFORMS 9+3

Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions – Inverse Fourier Transforms - Convolution theorem (without proof) – Parsevals's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Properties of Z-transform – Inverse Z-transform – Convolution theorem – Evaluation of Inverse Z transform using partial fraction method and convolution theorem - Initial and final value theorems – Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

Suggested Laboratory based exercises / assignments / assessments :

Ordinary differential equations

1. Symbolic computation of linear ordinary differential equations
2. Solving System of simultaneous linear differential equations using ODE SOLVER

Laplace transforms

1. Symbolic computation of Laplace transform and Inverse Laplace transform
2. Plotting Laplace transforms

Fourier Series

1. Symbolic computation of Fourier Coefficients
2. Computation of harmonics
3. Plotting truncated Fourier Series

Fourier Transform

1. Symbolic computation of Fourier Transforms
2. Plotting truncated Fourier Transforms

Z – transform

1. Symbolic computation of Z-Transforms

OUTCOMES:

CO1 :Solve higher order ordinary differential equations which arise in engineering applications.

CO2 :Apply Laplace transform techniques in solving linear differential equations.

CO3 :Apply Fourier series techniques in engineering applications.

CO4 :Understand the Fourier transforms techniques in solving engineering problems.

CO5 :Understand the Z-transforms techniques in solving difference equations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 45th Edition, New Delhi, 2020.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.

REFERENCES:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
2. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5 th Edition, New Delhi, 2017.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
5. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO 1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 5 :	3	3	2	3	1	2	1	1	1	1	1	3

CY23C01 **ENGINEERING CHEMISTRY** **L T P C**
3 0 2 4

UNIT I WATER TECHNOLOGY

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD, BOD, and heavy metals. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, Calgon, and carbonate treatment. External conditioning – demineralization. Municipal water treatment (screening, sedimentation, coagulation, filtration, disinfection-ozonolysis, UV treatment, chlorination), Reverse Osmosis – desalination.

PRACTICAL:

- Estimation of HCl using Na_2CO_3 as the primary standard
- Determination of alkalinity in the water sample.
- Determination of hardness of water by EDTA method.
- Determination of DO content of water sample by Winkler's method.

UNIT II NANOCHEMISTRY

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical, magnetic and catalytic). Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro-spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Applications of nanomaterials – medicine including AYUSH, automobiles, electronics, and cosmetics.

PRACTICAL:

- Preparation of nanoparticles by Sol-Gel method/sonication method.
- Preparation of nanowire by Electrospinning.
- Study of morphology of nanomaterials by scanning electron microscopy

UNIT III CORROSION SCIENCE

Introduction to corrosion – chemical and electrochemical corrosions – mechanism of electrochemical and galvanic corrosions – concentration cell corrosion-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Electrochemical protection – sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (galvanizing, tinning), organic coatings (paints). Paints: Constituents and functions.

PRACTICAL:

- Corrosion experiment-weight loss method.
- Salt spray test for corrosion study.
- Corrosion prevention by electroplating.
- Estimation of corroded Iron by Potentiometry/UV-visible spectrophotometer

UNIT IV ENERGY SOURCES

Electrochemical cell, redox reaction, electrode potential – oxidation and reduction potential. Batteries – Characteristics; types of batteries; primary battery (dry cell), secondary battery (lead acid, lithium-ion battery) and their applications. Emerging energy sources – metal hydride battery, hydrogen energy,

Fuel cells – H_2-O_2 fuel cell. Supercapacitors –Types and Applications, Renewable Energy: solar heating and solar cells. Recycling and disposal of batteries.

PRACTICAL:

- Study of components of Lead acid battery.
- Measurement of voltage in a photovoltaic cell.
- Working of H_2 – O_2 fuel cell

UNIT V POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: Tg, tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring. Polyamides, Polycarbonates and Polyurethanes – structure and applications. Recycling of polymers.

PRACTICAL:

- Determination of molecular weight of a polymer using Ostwald viscometer.
- Preparation of a polymer.
- Determination of molecular weight by Gel Permeation Chromatography.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

CO1: To demonstrate knowledge of water quality in various industries and develop skills in analyzing water quality parameters for both domestic and industrial purposes.

CO2: To identify and apply fundamental concepts of nanoscience and nanotechnology for engineering and technology applications, and to develop skills in synthesizing nanomaterials and studying their morphology.

CO3: To apply fundamental knowledge of corrosion protection techniques and develop skills to conduct experiments for measuring and preventing corrosion.

CO4: To study the fundamentals of energy storage devices and develop skills in constructing and experimenting with batteries.

CO5: To recognize and apply basic knowledge of different types of polymeric materials and develop skills in preparing and determining their applications for futuristic material fabrication needs.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Dara S.S., “A Textbook of Engineering Chemistry”, Chand Publications, 2004.
4. Laboratory Manual - Department of Chemistry, CEGC, Anna University (2023).

REFERENCES:

1. Schdeva M.V., “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd, 2011.

2. Friedrich Emich, “Engineering Chemistry”, Medtech, 2014.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.
4. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	3	-	-	-	-	-
CO2	3	-	2	-	2	-	3	-	-	-	-	-
CO3	3	3	2	-	2	-	3	-	-	-	-	-
CO4	3	3	-	-	-	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	3	-	-	-	-	-
Avg	3	3	-	-	-	-	3	-	-	-	-	-

1’ = Low; ‘2’ = Medium; ‘3’ = High

CS23C04 **PROGRAMMING IN C** **L T P C**
2 0 4 4

UNIT I BASICS OF C PROGRAMMING 6+12

Introduction to programming paradigms –- Structure of C program - C programming: Data Types - Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement.

PRACTICALS

1. Designing programs with algorithms/flowchart
2. Programs for i/o operations with different data types

SUGGESTED ACTIVITIES:

- EL - Programs using integer type, arithmetic operators and basic input/output.
- EL - Programs using other data types and operators.
- EL: Programs using else-if, switch

UNIT II LOOP CONTROL STATEMENTS AND ARRAYS 6+12

Iteration statements: For, while, Do-while statements, nested loops, break & continue statements - Introduction to Arrays: Declaration, Initialization - One dimensional array -Two dimensional arrays – Searching and sorting in Arrays – Strings – string handling functions - array of strings

PRACTICALS

1. Programs using various operators
2. Programs using decision making and branching statements
3. Programs using for, while, do-while loops and nested loops.
4. Programs using arrays and operations on arrays.
5. Programs implementing searching and sorting using arrays
6. Programs implementing string operations on arrays

SUGGESTED ACTIVITIES:

- EL: Programs using while, for,do-while, break, continue, enum.
- EL - Programs using arrays and operations on arrays.
- EL - Programs implementing string operations on arrays.
- EL - Programs using functions.

UNIT Ill FUNCTIONS AND POINTERS 6+12

Modular programming - Function prototype, function definition, function call, Built-in functions – Recursion – Recursive functions - Pointers - Pointer increment, Pointer arithmetic - Parameter passing: Pass by value, Pass by reference, pointer and arrays, dynamic memory allocation

PRACTICALS

1. Programs using functions
2. Programs using recursion
3. Programs using pointers & strings with pointers

4. Programs using Dynamic Memory Allocation

SUGGESTED ACTIVITIES:

- EL - Programs using recursion.
- EL - Programs using pointers and arrays, address arithmetic.
- EL - Programs using Dynamic Memory Allocation, two dimensional arrays and pointers.
- EL - Programs using Pointers and strings.

UNIT IV STRUCTURES AND UNION 6+12

Storage classes, Structure and union, Features of structures, Declaration and initialization of structures, array of structures, Pointer to structure, structure and functions, typedef , bit fields , enumerated data types, Union.

PRACTICALS

1. Programs using Structures
2. Programs using Unions
3. Programs using pointers to structures and self-referential structures.

SUGGESTED ACTIVITIES:

- EL - Programs using structures and arrays.
- EL - Programs using Pointers to structures, Self-referential structures.

UNIT V MACROS AND FILE PROCESSING 6+12

Preprocessor directives – Simple and Conditional macros with and without parameters - Files - Types of file processing: Sequential and Random access – File operations – read, write & seek.

PRACTICALS

1. Programs using pre-processor directives & macros
2. Programs to handle file operations
3. Programs to handle file with structure

SUGGESTED ACTIVITIES:

- EL - Programs using file operations in real-world applications

TOTAL: 90 (30+60) PERIODS

TEXT BOOKS:

1. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.

REFERENCE BOOKS:

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition,

Oxford University Press, 2013.
2. Ashok N Kamthane, Programming in C, Pearson, Third Edition, 2020
3. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
4. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C'" McGraw-Hill Education, 1996.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

COURSE OUTCOMES:

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

CO1: Write simple C programs using basic constructs.

CO2: Design searching and sorting algorithms using arrays and strings.

CO3: Implement modular applications using Functions and pointers.

CO4: Develop and execute applications using structures and Unions.

CO5: Illustrate algorithmic solutions in C programming language using files.

Total Hours: 90 (30+60)

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1	3	2	1	-	-	-	2	-	3	1	2	2
2	2	1	1	3	2	1	-	-	-	-	-	3	1	2	2
3	2	2	1	3	2	1	-	-	3	-	3	3	1	2	2
4	2	1	1	3	2	1	-	-	3	-	3	3	1	2	2
5	2	3	1	3	2	1	-	-	-	2	3	3	1	2	2

1 - low, 2 - medium, 3 – high

GY23C01	ENGINEERING GEOLOGY	L	T	P	C
		2	0	2	3

COURSEOBJECTIVES:

UNIT– I **INTRODUCTION AND GEOMORPHOLOGY** **6L,6P**

Significance of Geology in Civil Engineering; Internal structure of the Earth, Plate tectonics; Weathering and it types, weathering grade, engineering classification of weathered rocks. Geological works of rivers, wind, sea and glaciers as agents of erosion, transportation and deposition; physiographic forms and drainage patterns.

Practical component: Exposure to Toposheets; Identification of drainage pattern in a toposheet and preparation of drainage map; Preparation of weathered profile.

UNIT– II **MINERALS AND ROCKS** **6L,6P**

Introduction to minerals and rocks. Physical properties of Quartz, Feldspar, Mica, Olivine, Pyroxene, Amphibole and Clay minerals. Reactivity of alkaline minerals with cement and sand. Origin, texture, structure and properties Igneous (Granite, Syenite, Basalt & Dolerite), Metamorphic (Quartzite, Slate, Schist, Gneiss & Marble) and Sedimentary (Conglomerate, Sandstone, Shale & Limestone) rocks. Engineering properties of rocks.

Practical component: Identification of above mentioned minerals and rocks in hand specimens and writing their physical properties and uses. Modal analysis of rock specimens.

UNIT–III **STRUCTURAL GEOLOGY** **6L,6P**

Attitude of beds - Dip and Strike measurement. Relevance to civil engineering. Overview of folds, fractures, faults and joints in rocks. Relevance to civil engineering. Introduction to index properties of rocks- strength- structures and discontinuities in rocks, Geological factors controlling the strength of rock - influence on strength of rocks.

Practical component: Identification of rock structures, Strike and Dip measurements using Brunton Compass and Clinometer in the field.

UNIT– IV **GEOPROSPECTING AND GEOTECHNICAL PROPERTIES OF ROCKS** **6L,6P**

Reconnaissance surface investigations - Remote sensing and field surveys for geological mapping. Overview of Geophysical methods - Electrical, Seismic and GPR. Applications for subsurface investigations and groundwater exploration. Borehole core logging. Rock Mass Rating (RMR), Rock Quality Designation (RQD), Geological Strength Index (GSI), Q system for rock mass classification.

Practical component: Preparation of contour maps, Geologic cross sections, Litho-log preparation and RQD calculations.

UNIT– V **GEOLOGICAL CONSIDERATIONS FOR ENGINEERING STRUCTURES AND GEOHAZARDS** **6L,6P**

Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels and Road cuttings. Coastal protection. Earthquake - Seismic zones of India, Landslides - causes and mitigation. Tsunami - causes and mitigation. Case studies from India.

Practical component: Field study at a Dam / Reservoir / Tunnel / Road cutting site to recognize the geologicalconditionsnecessary for its construction.

TOTAL: 60 PERIODS

COURSEOUTCOMES:

Upon completion of the course, the 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

REFERENCES:

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.
3. Venkat Reddy, D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2021
4. Gokhale, K.V.G.K, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2019
5. Varghese, P.C., Engineering Geology for Civil Engineering, Prentice Hall of India Learning Private Limited, New Delhi, 2012.
6. Legget, “Geology and Engineering”, McGraw Hill Book company, 1998 Blyth, “Geology for Engineers”, ELBS 1995.
7. Krynine and Judd, “Principals of Engineering Geology and Geotechnics” Tata McGraw Hill, New Delhi, 2018.
8. Bell, F.G. Fundamentals of Engineering Geology, B.S. Publications. Hyderabad 2011

Mapping of CO with PO

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	2	-	-	2	2	-	-	-	2	-	-	-	2	-	-
3	2	2	3	3	-	-	-	-	2	-	-	-	-	-	2
4	-	2	-	3	2	2	2	2	-	-	2	2	2	2	-
5	-	3	3	3	-	2	2	2	2	2	2	2	2	2	2
Avg.	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

ME23C03 **ENGINEERING MECHANICS** **L T P C**

3 1 0 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Determining the resultant forces acting on a particle in 2D and 3D and for applying methods of equilibrium on a particle in 2D and 3D.
- Evaluating the reaction forces for bodies under equilibrium, for determining the moment of a force, moment of a couple, for resolving force into a force-couple system and for analyzing trusses
- Assessing the centroids of 2D sections / center of gravity of volumes and for calculating area moments of inertia for the sections and mass moment of inertia of solids.
- Evaluating the frictional forces acting at the contact surfaces of various engineering systems and for applying the work-energy principles on a particle.
- Determining kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES 9+3

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES AND TRUSSES 9+3

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections – Analysis of Trusses – Method of Joints and Method of Sections.

UNIT III DISTRIBUTED FORCES 9+3

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION AND WORK PRINCIPLES 9+3

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction. Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

UNIT V DYNAMICS OF PARTICLES AND RIGID BODIES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods – Kinematics of Rigid Bodies and Plane Kinetics.

TOTAL : 60 Periods

COURSE OUTCOMES:

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

1. To determine the resultant forces acting on a particle in 2D and 3D and to apply methods of equilibrium on a particle in 2D and 3D.
2. Evaluate the reaction forces for bodies under equilibrium, to determine moment of a force, moment of a couple, to resolve force into a force-couple system and to analyze trusses
3. Assess the centroids of 2D sections / center of gravity of volumes and to calculate area moments of inertia for the sections and mass moment of inertia of solids.
4. Evaluate the frictional forces acting at the contact surfaces of various engineering systems and apply the work-energy principles on a particle. evaluate the kinetic and kinematic parameters of a particle.
5. Determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12th Edition, 2019.

2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3									3		
2	3	3	2	3									3		
3	3	3	2	3									3		
4	3	3	2	3									3		
5	3	3	2	3									3		
Avg	3	3	2	3									3		

UC23H02 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**

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

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: **3**

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

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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

UC23H02 **TAMILS AND TECHNOLOGY** **L T P C**
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE ANDIRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompuof Chola Period,Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing -KnowledgeofSea -Fisheries – Pearl - Conche diving - Ancient Knowledge ofOcean -KnowledgeSpecificSociety.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCEBOOKS

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

by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CE23301 **STRENGTH OF MATERIALS - I** **L T P C**
3 0 2 4

UNIT I SIMPLE AND COMPOUND STRESSES 9+6

Rigid and deformable bodies - Types of stresses - Deformation of simple and compound bars - Thermal stresses - Biaxial state of stress - Elastic constants - Stresses and deformation of thin cylindrical and spherical shells - Stresses at a point - Stresses on inclined planes - Principal stresses and principal planes - Mohr's circle of stresses.

PRACTICALS: Compression test on wood, Impact test on metal specimen (Izod and Charpy), Hardness test on metals (Rockwell and Brinell Hardness Tests)

UNIT II BENDING OF BEAMS 9+6

Types of loads, supports, beams - Relationship between intensity of load, shearing force and bending moment - Shearing force and bending moment diagrams for statically determinate beams (cantilever, simply supported and overhanging beams) with concentrated load, UDL, uniformly varying load, concentrated moment - Theory of simple bending - Stress distribution at a cross section due to bending moment and shearing force - Flitched beams - Leaf springs.

PRACTICALS: Double shear test on metal, Deflection test on carriage spring

UNIT III DEFLECTION OF BEAMS 9+6

Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slopes and deflections of determinant beams.

PRACTICALS: Deflection test on metal beam

UNIT IV TORSION 9+6

Theory of torsion - Stresses and deflection in solid and hollow circular shafts - Power transmitted by shafts - Combined bending moment and torsion on shafts - Shaft in series and parallel - Closed and open coiled helical springs - Springs in series and parallel - Design of buffer springs.

PRACTICALS: Torsion test on mild steel rod, Compression test on helical spring

UNIT V ANALYSIS OF TRUSSES 9+6

Determinate and indeterminate trusses - Analysis of determinate plane trusses - Assumptions - Method of joints - Method of sections - Deflections of pin-jointed plane frames - Lack of fit - Change in temperature - Method of tension coefficient - Application to space trusses.

PRACTICALS: Tension test on mild steel rod

TOTAL: 45L + 30P = 75 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the concepts of stress, strain, principal stresses and principal planes and the mechanical properties of materials such as tension, compression and hardness

CO2 Determine shearing forces, bending moments and their stress distributions in the determinate beams, along with the double shear and impact properties of metals

CO3 Calculate the slope and deflection of beams by different methods and verify the deflection of beams and carriage springs experimentally

CO4 Gain knowledge on theory of torsion, power transmitted by circular shafts, stresses and deformation of helical springs, with experimental insight

CO5 Analyze determinate plane and space trusses

TEXTBOOKS:

1. Punmia B. C., Ashok Kumar Jain & Arun Kumar Jain, "Strength of Materials (SMTS 1)", Laxmi Publications, New Delhi, 2011.
2. Rajput R. K., “Strength of Materials”, S. Chand and Co., New Delhi, 2015.

REFERENCES:

1. “Strength of Materials Laboratory Manual”, Anna University, Chennai - 600025.
2. IS 432 (Part I) -1992, “Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement”.
3. Gambhir M. L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
4. Timoshenko S. B. and Gere J. M., “Mechanics of Materials”, Van Nos Reinbhold, New Delhi, 1999.
5. Vazirani V. N. and Ratwani M. M., “Analysis of Structures”, Vol I Khanna Publishers, New Delhi,1995.
6. Ugural A. C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.
7. https://cfd.annauniv.edu/coursematerial/strength-of-materials.pdf

CO-PO & PSO MAPPING: STRENGTH OF MATERIALS - I

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	2	2	2	3	3	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	3	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	3	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	3	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**3**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23302 CONSTRUCTION ENGINEERING L T P C
3 0 2 4

UNIT I STONES AND BRICKS 9+6

Stone as building material - Criteria for selection - Tests on stones - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive strength - Water Absorption - Efflorescence - Bricks for special application.

PRACTICALS: Test on bricks - Test for compressive strength - IS 3495 (Part 1): 1992 R(2002), Test for water absorption - IS 3495 (Part 2): 1992 R(2002), Determination of efflorescence - IS 3495 (Part 3): 1992 R(2002)

UNIT II LIME, CEMENT AND CONCRETE 9+6

Lime - Uses - Preparation of lime mortar - Cement - Ingredients - Mechanism of hydration - Cement mortar - Test on cement - Aggregates - Fine and coarse aggregates - Test on aggregates - Ingredients for concrete - Water cement ratio - Concrete blocks - Paver blocks - Hollow blocks - Lightweight concrete blocks.

PRACTICALS:

Test on cement: Determination of fineness - IS 4031 (Part 1) : 1996 R(2005), Determination of consistency - IS 4031 (Part 4) : 1988 R(2005), Determination of initial and final setting time - IS 4031 (Part 4) : 1988 R(2005), Determination of specific gravity - IS 4031 (Part 2) : 1999 R(2004)

Test on fine aggregates: Grading of fine aggregates - IS 383 : 2016, Test for specific gravity – IS 2386 (Part 3) : 1963 R(2002), Compacted and loose bulk density of fine aggregate - IS 2386 (Part 3) : 1963 R(2002)

Test on coarse aggregate: Determination of specific gravity - IS 2386 (Part 3) : 1963 R(2002), Determination of impact value - IS 2386 (Part 3) : 1963 R(2002), Determination of elongation index - IS 2386 (Part 1) : 1963 R(2002), Determination of flakiness index - IS 2386 (Part 1) : 1963 R(2002), Determination of aggregate crushing value - IS 2386 (Part 3) : 1963 R(2002)

Test on concrete: Concrete mix proportioning and testing on fresh concrete - IS 516 : 1959 R(2004), Testing on hardened concrete - IS 516 (Part 1/Sec 1) : 2021

UNIT III SUPPLEMENTARY MATERIALS 9+6

Timber - Market forms - Plywood - Veneer - False ceiling materials - Laminates - Steel - Mechanical treatment - Aluminium - Uses - Market forms - Glass - Refractories - Composite Materials - FRP - Geo synthetics - Floor finishing materials - Bitumen - Nano materials.

PRACTICALS: Test on glass (only demonstration)

UNIT IV CONSTRUCTION PRACTICES 9+6

Stone masonry - Brick masonry - Cavity walls - Flooring - Formwork - Centering and shuttering - Sheet piles - Slip and moving forms - Roofs and roof covering - Plastering and pointing - Shoring - Scaffolding - Underpinning - Submerged structures - New technologies (activity-based).

PRACTICALS: Permeability test (only demonstration)

UNIT V SERVICE REQUIREMENTS 9+6

Painting, distempering and white washing - Surface preparation and defects in painting and distempering and white washing - Fire Protection - Thermal insulation - Ventilation and air conditioning - Acoustics and sound insulation - Damp proofing - Termite proofing.

PRACTICALS: NDT tests (only demonstration)

TOTAL: 45L + 30P = 75 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Identify the good qualities of stones and determine the suitable properties of aggregates for construction through testing techniques
CO2	Have thorough knowledge on lime, cement, concrete and their products, along with the practical testing of their characteristics
CO3	Classify the bricks suitable for construction and recognize the market forms of other construction materials such as timber, plywood, steel, aluminium etc.
CO4	Explore the various construction practices and practical importance
CO5	Impart knowledge on appropriate service requirements and perform non-destructive tests at site locations

TEXTBOOKS:

1. Varghese P. C., “Building Construction”, Second Edition, PHI Learning Ltd., 2016.
2. Gambhir and Neha Jamwal, “Building and Construction Materials”, Second Edition, McGraw Hill Education Pvt. Ltd., 2015.

REFERENCES:

1. Construction Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS 4031 (Part 1) - 1996 R(2005) - Indian Standard.
3. IS 4031 (Part 2) : 1999 R(2004)
4. IS 4031 (Part 3 and Part 5) - 1988.
5. IS 4031 (Part 4) : 1988 R(2005).
6. IS 2386 (Part 1 & Part 3) : 1963 R(2002)
7. IS 3495 (Part 1, Part 2 & Part 3): 1992 R(2002)
8. IS 2386 (Part 1 to Part 6) - 1963 R(2002).
9. IS 516 : 1959 R(2004)
10. IS 383 - 2016, Indian Standard specification for coarse and fine aggregates from natural sources for concrete.
11. Arora S. P. and Bindra S. P., “Building Construction”, Dhanpat Rai and Sons,1997.
12. Ponmalar. V, கட்டுமான பொருட்கள், Construction Materials (Tamil book), 2011.
13. Punmia B. C., “Building Construction”, Laxmi Publication (p) Ltd., 2008.
14. Neville A. M., “Properties of Concrete”, Fourth Edition, Pearson Education Ltd, 2012.

CO-PO-PSO MAPPING: CONSTRUCTION ENGINEERING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	2	3	2	2	3	2	3	3	2	2	3	3
2	3	2	3	3	3	3	2	3	2	3	3	3	3	3	3
3	2	3	2	2	2	2	3	2	2	3	3	3	3	2	3
4	3	2	3	3	3	2	2	3	3	2	2	3	2	2	3
5	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

CE23303 **FLUID MECHANICS** **L T P C**
3 0 2 4

UNIT I FLUIDS PROPERTIES AND FLUID STATICS 13

Definitions of a fluid - Fluid properties - Methods of analysis - System and Control volume approach - Fluid pressure and it's measurements - Forces on plane and curved surfaces - Buoyancy and floatation - Meta centric height and its application.

PRACTICALS: Determination of metacentric height of floating bodies.

UNIT II FLUID FLOW CONCEPTS 17

Classification of flows - Streamline, streak-line and path-lines - Stream function and velocity potentials - Flow nets; Principles of mass, energy and momentum conservation - Euler's equation of motion - Bernoulli's equation - Applications to velocity and discharge measurements - Linear momentum equation - Application to pipe bends.

PRACTICALS: Calibration of Venturimeter, Calibration of Rotameter

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 13

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

PRACTICALS: Physical model study of a sluice gate

UNIT IV REAL FLUID FLOW 17

Reynolds experiment - Laminar flow in pipes - Hagen - Poiseuille's equation- Darcy-Weisbach equation - Moody's diagram - Major and minor losses in pipes - Pipes connected in series and parallel - Equivalent pipes.

PRACTICALS: Determination of friction factor in pipes, Determination of minor losses

UNIT V BOUNDARY LAYERS 15

Definition of boundary layers - Laminar and turbulent boundary layers - Displacement, momentum and energy thickness - Von-Karman Momentum integral equation - Applications – Drag and Lift - Boundary layer separation - Control measures.

PRACTICALS: Wind Tunnel Demonstration

TOTAL: 45L + 30P = 75 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Demonstrate the difference between solid and fluid, its properties and behaviour in static conditions

CO2 Apply the conservation laws applicable to fluids and its application through fluid kinematics and dynamics

CO3 Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies

CO4 Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel

CO5 Explain the concept of boundary layer and its application to find the drag force excreted by the fluid on the flat solid surface

TEXTBOOKS:

1. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, 22nd Ed., Standard Book House New Delhi, 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2015.

REFERENCES:

1. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill, NewDelhi, 1998.
4. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2023.

CO-PO & PSO MAPPING: FLUID MECHANICS

CO	PO												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	1	2	2	2	1	2	1	3	3	2	3
2	3	3	2	3	1	2	2	2	1	2	1	3	3	2	3
3	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3
4	3	3	3	3	1	3	2	2	1	2	1	3	3	2	3
5	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3
Avg.	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3

CE23304 RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING L T P C
3 0 0 3

UNIT I RAILWAY TRANSIT AND PLANNING 9

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

UNIT II RAILWAY CONSTRUCTION AND MAINTENANCE 9

Earthwork - Stabilization of track on poor soil - Tunneling Methods, drainage and ventilation - Calculation of Materials required for track laying - Construction and maintenance of tracks -Signalling - Railway Station and yards and passenger amenities

UNIT III AIRPORT PLANNING 9

Air transport characteristics-airport classification- site selection, airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, typical Airport Layouts, parking and Circulation Area, Terminal area planning- Passenger Facilities and Services

UNIT IV AIRPORT DESIGN 9

Runway Design: Orientation, Wind Rose Diagram, correction factors as ICAO stipulations Problems on basic and actual Length, Geometric Design, Configuration and Pavement Design Principles - Elements of Taxiway Design - Airport Zones - Runway and Taxiway Markings & Lighting

UNIT V HARBOUR ENGINEERING 9

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides - Planning and Design of Harbours: Requirements, Classification, Location and Design Principles - Harbour Layout and Terminal Facilities - Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage - Wave action on Coastal Structures and Coastal Protection Works - Environmental concern of Port Operations- Inland Water Transport.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Understand the concepts and elements in Planning, Design and construction of Railways
CO2 Select appropriate methods for construction and maintenance of railway tracks and other infrastructures
CO3 Understand the concepts and elements in Planning and selection of site for Airport
CO4 Design the Runway length and evaluate the orientation of runways
CO5 Understand the terminologies, infrastructures in Harbour Engineering and Coastal regulations

TEXTBOOKS:

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010
2. C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
3. Vazirani.V.N and Chandola.S.P, “Transportation Engineering-Vol.II”, Khanna Publishers, New Delhi, 2015.
4. Sirinivasa Kumar R Transportation Engineering Railways, Airports, Docks and Harbours. University Press 2014
5. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998

REFERENCES:

1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand andBros, Roorkee, 1994
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.

CO-PO & PSO MAPPING: RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	1	1	1	2	2	1	1	3	3	2	3
2	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2
3	2	2	3	3	2	3	3	2	2	3	2	2	3	2	2
4	3	2	3	3	3	2	3	3	2	3	2	2	2	2	2
5	2	3	3	2	2	2	3	1	1	1	1	3	2	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23305 WATER SUPPLY ENGINEERING L T P C
3 0 2 4

UNIT I SOURCES AND QUALITY OF WATER 9+6

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics – Analytical techniques, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

Practicals:

Determination of Turbidity - IS 3025(Part 10)-1984 R(2002)
Determination of pH in water - IS 3025 (Part 11)-1983R(2002)

UNIT II COLLECTION AND CONVEYANCE OF WATER 9+6

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

Practicals:

Determination of Total Dissolved Solids in water - IS 3025 (Part 16)-1984 R(2006)
Determination of total hardness in water - IS 3025 (Part 21)-R (2009)

UNIT III CONVENTIONAL WATER TREATMENT 9+6

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

Practicals:

Determination of Total Dissolved Solids in water - IS 3025 (Part 16)-1984 R(2006)
Determination of total hardness in water - IS 3025 (Part 21)-R (2009)

UNIT IV ADVANCED WATER TREATMENT 9+6

Water softening – Iron and Manganese removal - Defluoridation - Adsorption - Desalination- R.O. Plant – demineralization process –Ion exchange– Membrane Systems – RO Reject Management - Operation & Maintenance aspects – Recent advances.

Practicals:

Determination of alkalinity in water - IS 3025 (Part 23)-1986 R (2003)
Determination of Sulphate in water - APHA 23rd Edition-4500-SO_4^{2-} E
Determination of fluoride in water - IS 3025 (Part 60)-2008

UNIT V WATER DISTRIBUTION AND SUPPLY 9+6

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs Functions – Network design – Analysis of distribution networks – Appurtenances – Leak detection. Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

Practicals:

Determination of iron in water - IS 3025 (Part 53)- 2003

Determination of free residual chlorine in water - IS 3025 (Part 26)1986 R(2003)
Determination of Optimum Coagulant Dosage by Jar test apparatus - IS 3025 (Part 50) 2002

TOTAL: 45L + 30P = 75 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1	Understand the various components of water supply scheme
CO2	Design of intake structure and conveyance system for water transmission
CO3	Understand the process of conventional treatment of water and design of water treatment system.
CO4	Able to Understand and design the various advanced treatment system and knowledge about the recent advances in water treatment process
CO5	Ability to design and evaluate water distribution system and water supply in buildings

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.

REFERENCES:

1. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2010.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
3. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.
4. American Public Health Association, American Water Works Association, Water Environment Federation. Lipps WC, Braun-Howland EB, Baxter TE, eds. *Standard Methods for the Examination of Water and Wastewater*. 24th ed. Washington DC: APHA Press; 2023

CO-PO & PSO MAPPING: WATER SUPPLY ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	-	3	-	3	-	2	-	1	-	-	3	2	3
2	3	2	2	-	2	-	3	-	2	-	-	-	3	2	-
3	3	2	3	-	-	-	3	-	2	-	-	-	3	2	-
4	-	2	-	-	3	-	3	-	-	-	-	2	3	2	-
5	3	2	3	2	-	3	-	2	-	-	2	-	3	3	-
Avg.	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**

• 1' = Low; '2' = Medium; '3' = High

CE23C04 **PRINCIPLES OF SURVEYING** **L T P C**
3 0 4 5

UNIT I LEVELLING AND THEODOLITE SURVEYING 9 L, 28P

Datum - Benchmarks - Levels and staves - Temporary and permanent adjustments - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking - Reduction Contouring - Methods of interpolating contours - Characteristics and uses of contours -Theodolite - Types - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Trigonometric levelling - Heights and distances - Single plane method - Double plane method - Geodetic observation - Tacheometric surveying - Stadia tacheometry - Subtense method - Tangential tacheometry.

PRACTICALS

- Determination of elevation of given points by fly levelling using a dumpy level.
- Transfer of Bench Mark by Check Levelling using Tilting level.
- Contour Mapping using Grid Levelling and determine the Cut and fill volume.
- Measurement of horizontal angle and its accuracy by Repetition method.
- Measurement of horizontal angles and their weights by the Reiteration method.
- Mapping of Topographic Features by Stadia tacheometry surveying.
- Determination of Length and Reduced Level of points on sloping terrain using tacheometric surveying.

UNIT II CONTROL SURVEYING AND ADJUSTMENT 9L, 4P

Horizontal and vertical control - Methods - Triangulation - Baseline - Instruments and accessories - Corrections - Satellite station - Traversing - Coordinate computation - Gale‘s table - Omitted measurement - Trilateration - Concepts of measurements and errors - The weight of an observation - Law of weight - Adjustment methods - Angles, lengths and levelling network - Simple problems.

PRACTICALS

- Establishment of Horizontal Control Points by Traverse surveying.

UNIT III TOTAL STATION 9L, 20P

Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - Total station: Parts and accessories – classification - Electro-optical system- Microwave system - Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments - Observables - Errors - COGO functions - Field procedure and applications

PRACTICALS

- Study of Total station and measurement of Angle, Distance, and Coordinate measurement.
- To determine the instrument station coordinate: Orientation by back site and Resection methods (Angles only and Distances only). To determine the height of the tower/column/power transmission line by REM method.
- To determine the perimeter of a polygon by MLM / Inverse method and the area of a polygon
- (some points are inaccessible points, that are to be determined by different offset methods).
- Topographic mapping and Preparation of Contour map using Total Station.

UNIT IV GNSS SATELLITE SYSTEM **9L, 8P**

Basic concepts of GPS – Resection principle - Historical perspective and development - applications - Geoid and Ellipsoid - satellite orbital motion - Keplerian motion - Kepler's Law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept - GNSS - Galileo, BeiDou, GLONASS, IRNSS and GAGAN, QZSS - Different segments - Space, control and user segments - satellite configuration – Signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment – Receivers - Planning and data acquisition - Data processing - Errors in GPS - Field procedure and applications

PRACTICALS

- Navigation and Feature collection using handheld GPS
- GNSS Planning of points with and without obstructions.
- Accuracy evaluation of baseline with different common observation times using GNSS

UNIT V PHOTOGRAMMETRY AND UAV **9**

Definition: Types and uses of Photogrammetry-aerial and terrestrial, metric and non-metric - Platform for photogrammetric sensing systems – Perspective Projection - Scale and Coverage - Vanishing points - Image coordinate system - Relief displacement – Parallax – Stereo – UAV – Definition – difference between aircraft and UAV – Types and characteristics of drones

TOTAL: 105 PERIODS (45 (THEORY) + 60 (PRACTICAL))

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Gain a solid understanding of the fundamental principles and concepts of surveying, including measurements, coordinate systems, accuracy, error analysis, and surveying instruments
CO2 Plan and conduct field surveys effectively
CO3 Conduct surveys to accurately measure and map the features, contours, and elevations of a given area of land using appropriate surveying techniques and equipment
CO4 Analyse survey data using appropriate mathematical and statistical techniques, interpret the results, and generate accurate reports, drawings, and maps based on the collected data
CO5 Imparts the knowledge of modern surveying instruments

TEXT BOOKS:

1. T. P. Kanetkar and S. V. Kulkarni, "Surveying and Levelling", Part 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th edition, 2010, ISBN-10: 8185825114, ISBN-13: 978-8185825113.
2. Dr B. C. Punmia, Ashok K. Jain and Arun K Jain, "Surveying Vol. I & II", Lakshmi Publications Pvt Ltd, New Delhi, 16th edition, 2016, ISBN-10: 9788170088530, ISBN-13:978-8170088530.

REFERENCES:

1. R. Subramanian, "Surveying and Levelling", Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13: 978-0198085423.
2. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", McGraw Hill, 7th edition, 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. Bannister and S. Raymond, "Surveying", Longman, 7th edition, 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.
4. S. K. Roy, "Fundamentals of Surveying", Prentice Hall of India, 2nd edition, 2004, ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K. R. Arora, "Surveying Vol I & II", Standard Book House, 2019, ISBN-13: 9788189401238.

6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, 2nd edition, 2011, ISBN-10: 9788173717406, ISBN-13: 978-8173717406.
7. Günter Seeber, “Satellite Geodesy”, Walter de Gruyter, Berlin, 2nd revised and extended edition, 2003.

CO-PO & PSO MAPPING: SURVEYING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	3	1	2	3	2	1	2	3	3	3
2	3	3	3	3	2	3	2	2	3	1	1	2	3	3	3
3	3	3	3	2	3	3	2	2	3	1	1	3	3	3	3
4	3	2	3	3	3	3	1	2	3	2	1	3	3	3	3
5	3	3	3	3	3	3	2	1	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

SEMESTER IV

CE23401 STRENGTH OF MATERIALS - II L T P C
3 0 0 3

UNIT I ENERGY PRINCIPLES 9

Strain energy and strain energy density - Strain energy due to axial load, shear, flexure and torsion - Castigliano's theorems - Maxwell's reciprocal theorem - Principle of virtual work - Computing deflections in beams, frames and trusses.

UNIT II INDETERMINATE BEAMS 9

Static and kinematic indeterminacies - Concept of analysis - Propped cantilever and fixed beams - Fixed end moments and reactions - Theorem of three moments - Analysis of continuous beams - Shear force and bending moment diagrams.

UNIT III COLUMNS 9

Euler's column theory - Critical load for prismatic columns with different end conditions - Effective length - Rankine-Gordon formula for eccentrically loaded columns - Eccentrically loaded short columns - Middle third rule - Middle fourth rule - Core section.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 9

Determination of principal stresses and principal planes - Thick cylinders - Compound cylinders - Shrinking on stresses - Theories of failure - Maximum principal stress theory - Maximum principal strain theory - Maximum shear stress theory - Maximum strain energy theory - Energy of distortion theory - Applications.

UNIT V ADVANCED TOPICS IN BENDING OF BEAMS 9

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections - Shear centre - Curved beams - Winkler Bach formula - Stresses in links and hooks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Apply the concepts of energy principle for determining deflection of beams, frames, and trusses
CO2 Analyze indeterminate beams using theorem of three moment equations
CO3 Assess the load carrying capacity of long columns and stresses in short columns
CO4 Determine the principal stresses in three-dimensional state of stress, analyze the stresses in thick cylinders and apply various theories of failures
CO5 Gain knowledge in the concept of shear centre, unsymmetrical bending and curved beams

TEXT BOOKS:

1. Rajput R. K. "Strength of Materials", S. Chand & company Ltd., New Delhi, 2015.
2. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures (SMTS 2)", Laxmi Publishing Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Srivastava A. K. and Gope P. C., "Strength of Materials", PHI Learning Private Limited, Delhi, 2014.
2. Rattan S. S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

3. Ghosh. D, " Advanced Strength of Materials", New Age International Publishers, New Delhi, 2015.
4. Egor P. Popov, “Engineering Mechanics of Solids”, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Kamal Kumar and Ghai, “Advanced Mechanics of Materials”, Khanna Publishers, Delhi, 2015.

CO-PO & PSO MAPPING: STRENGTH OF MATERIALS - II

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23402 **SOIL MECHANICS** **L T P C**
3 0 4 5

UNIT I SOIL CLASSIFICATION 9

Formation of soil - Soil description – Particle size, shape and colour – Soil structure – Phase relationship – Index properties – Atterberg limits – Grain size distribution – BIS and Unified soil classification system – Significance.

PRACTICAL 20

DETERMINATION OF INDEX PROPERTIES (20)

Specific gravity of soil solids - IS 2720: Part 3: 1980 (Reaffirmed 2021) -- Grain size distribution: Sieve analysis - IS 2720: Part 4: 1985 (Reaffirmed 2020) -- Grain size distribution: Hydrometer analysis - IS 2720: Part 4: 1985 (Reaffirmed 2020) -- Liquid limit and Plastic limit tests - IS 2720: Part 5: 1985 (Reaffirmed 2020) -- Shrinkage limit and Differential free swell tests - IS 2720: Part 6: 1972 (Reaffirmed 2021) and IS 2720: Part 40: 1977 (Reaffirmed 2021)

UNIT II COMPACTION, EFFECTIVE STRESS AND PERMEABILITY 9

Compaction of soils – Laboratory tests – Field Compaction methods – Factors influencing compaction of soils - Soil water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena – Darcy's law – Determination of Co-efficient of permeability – Laboratory Determination (Constant head and falling head methods) and field measurement - Pumping out test in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two-dimensional flow – Laplace equation – Introduction to flow nets – Determination of seepage loss and exit hydraulic gradient.

PRACTICAL 16

DETERMINATION OF INSITU DENSITY & COMPACTION CHARACTERISTICS (8)

Field density Test (Sand replacement method) - IS 2720: Part 28: 1974 (Reaffirmed 2020) -- Determination of moisture – density relationship using standard proctor compaction test. - IS 2720: Part 7: 1980 (Reaffirmed 2021)

DETERMINATION OF PERMEABILITY (8)

Permeability determination (constant head and falling head methods) - IS 2720: Part 17: 1986 (Reaffirmed 2021) and IS 2720: Part 36: 1987 (Reaffirmed 2021)

UNIT III STRESS DISTRIBUTION AND SETTLEMENT 9

Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point load, Line load and uniformly distributed load) Use of New marks influence chart –Components of settlement — Immediate and consolidation settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement - $\sqrt{t}$ and log t methods– e-log p relationship.

PRACTICAL 4

DETERMINATION OF CONSOLIDATION CHARACTERISTICS (4)

One dimensional consolidation test (Determination of co-efficient of consolidation only) - IS 2720: Part 15: 1965 (Reaffirmed 2021)

UNIT IV SHEAR STRENGTH 9

Shear strength of cohesive and cohesionless soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, Unconfined compression and Vane shear tests – Pore pressure parameters.

PRACTICAL **12**

DETERMINATION OF SHEAR STRENGTH (12)

Direct shear test in cohesionless soil - IS 2720: Part 13: 1986 (Reaffirmed 2021) -- Unconfined compression test in cohesive soil - IS 2720: Part 10: 1991 (Reaffirmed 2020) -- Laboratory vane shear test in cohesive soil - IS 2720: Part 30: 1980 (Reaffirmed 2021)

UNIT V SLOPE STABILITY **9**

Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices – Fellenius method - Slope protection measures - Land reclamation.

PRACTICAL **8**

DETERMINATION OF TRIAXIAL STRENGTH AND CBR (8)

Tri-axial compression test in cohesionless soil (Demonstration only) - IS 2720: Part 11: 1993 (Reaffirmed 2021) and IS 2720: Part 12: 1981 (Reaffirmed 2021) -- California Bearing Ratio Test - IS 2720: Part 16: 1987 (Reaffirmed 2021)

Unit	Distribution of Theory and Practical Classes (in Hrs.)					
	I	II	III	IV	V	Total
Theory	9	9	9	9	9	45
Practical	20	16	4	12	8	60
Total	29	25	13	21	17	105

TOTAL: 105 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1 Evaluate the index properties of soil using laboratory tests and used for the classification of the soil according to codal provisions.

CO2 Determine the permeability of water flow through soil medium and seepage through soil to understand its impact on engineering solutions.

CO3 Calculate the stress distribution in loaded soil medium for arriving the soil settlement due to consolidation.

CO4 Estimate the shear strength of soils for understanding its impact on engineering solutions.

CO5 Analyse the stability of finite and infinite slopes and arrive at slope protection measures.

TEXTBOOKS:

1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi. 2015
2. Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Ltd. International Publisher New Delhi (India) 2006.

REFERENCES:

1. McCarthy, D.F., “Essentials of Soil Mechanics and Foundations”. Prentice-Hall, 2006.
2. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India

Pvt. Ltd. New Delhi, 2010.
3. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
4. Punmia, B.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd. New Delhi, 2005.
5. “Soil Engineering Laboratory Instruction Manual” published by Engineering College Co-operative Society, Anna University, Chennai, 2010.
6. Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, New age International (P) limited publishers, New Delhi, 2008.
7. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.
8. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
9. Braja M. Das., “Soil Mechanics: Laboratory Manual”, Oxford University Press, eighth edition, 2012.

CO – PO – PSO Mapping – SOIL MECHANICS

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	3	3	2	2	2	2	3	3	3	3
2	3	2	3	3	2	2	3	2	2	2	2	3	3	2	2
3	3	3	2	3	2	2	2	2	2	2	2	3	3	2	2
4	3	3	3	3	2	2	2	2	2	2	2	3	3	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	3	3	2	3	2	2	2	2	2	2	2	3	3	2	2

CE23403 APPLIED HYDRAULIC ENGINEERING L T P C
3 0 2 4

UNIT I UNIFORM FLOW 15

Definition and differences between pipe flow and open channel flow -Types of Flow - Properties of open channel - Fundamental equations - Subcritical, Supercritical and Critical flow - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy - Channel transitions (vertical and horizontal).

PRACTICALS: Calibration of weir

UNIT II VARIED FLOWS 13

Dynamic equation of gradually varied flow - GVF profile classifications - Profile determination by numerical methods: Direct step method and standard step method - Break in grades.

PRACTICALS: Calibration of V notch

UNIT III RAPIDLY VARIED FLOWS 13

Application of the momentum equation for RVF - Hydraulic jump - Types -Sequent depth ratio - Energy dissipation - Unsteady RVF - Positive and negative surges - Applications.

PRACTICALS: Determination of head loss in hydraulic jump

UNIT IV TURBINES 17

Impact of jets on moving vanes – Velocity triangle - Turbines - Classification - Working principles - Pelton wheel - Francis turbine - Kaplan turbine - Efficiencies - Draft tube - Characteristics curves - Specific speed - Runaway speed.

PRACTICALS: Characteristics of Pelton wheel turbine, Characteristics of Francis turbine

UNIT V PUMPS 17

Types - Centrifugal pumps - Working principles - Efficiencies - Minimum speed to start the pump - NPSH - Cavitation in pumps - Characteristics curves - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done.

PRACTICALS: Characteristics of Centrifugal pumps, Characteristics of Reciprocating pump

TOTAL: 45L + 30P = 75 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

- **CO1** Describe the basics of open channel flows, its classifications and analysis of uniform flow in steady state conditions with specific energy concept and its application
- **CO2** Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades
- **CO3** Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges
- **CO4** Design of Pelton wheel, Francis and Kaplan turbines and explain the working principles of each turbine with draft tube theory for reaction turbines
- **CO5** Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps Determine the performance characteristics of turbines

TEXT BOOKS:

1. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2000.
2. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi, 2010.
3. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 19th edition, 2013.

REFERENCES:

1. VenTe Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
2. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017.
3. Sturm T.W., Open Channel Hydraulics - Tata-McGraw Hill 2nd edition, New Delhi 2011.
4. Srivastava R. Flow through Open Channels Oxford University Press New Delhi, 2008.
5. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.

CO-PO & PSO MAPPING: APPLIED HYDRAULIC ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	2	1	2	1	2	3	2	1
2	3	2	1	1	1	1	1	2	1	2	1	2	3	2	1
3	3	2	3	2	1	1	1	2	1	2	1	2	3	3	2
4	3	3	3	2	1	1	1	3	1	2	1	3	3	3	3
5	3	3	2	2	1	1	1	3	1	2	1	3	3	3	3
Avg.	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**2**

CE23404 HIGHWAY ENGINEERING L T P C
3 0 4 5

UNIT I HIGHWAY PLANNING AND ALIGNMENT 9

History of road development in India - Classification of highways - Institutions for Highway planning, design and construction at different levels - factors influencing highway alignment - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods. Typical cross sections of Urban and Rural roads - cross sectional elements.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 9

Importance of geometric design, Sight distance - stopping sight distance-overtaking sight distance - sight distance at intersections, Design of horizontal alignment - super elevation, widening of pavements, transition curves. Design of vertical alignment - gradients, summit, and valley curves- IRC standards-Road signs and safety. Urban utility services.

UNIT III DESIGN OF FLEXIBLE PAVEMENTS 60

Desirable properties of subgrade soil, road aggregates and bituminous materials, testing methods - Pavement components and their functions - Factors influencing the design of pavements - Design principles - Design of flexible pavements as per IRC.

PRACTICALS:

I TEST ON AGGREGATES

a) Sieve Analysis-IS 2386 (Part 1), Reaffirmed 2021
b) Flakiness and Elongation Test of Aggregates- IS 2386 (Part 1), Reaffirmed 2021
c) Specific Gravity of Aggregates- IS 2386 (Part 3), Reaffirmed 2021
d) Aggregate Impact Value- IS 2386 (Part 4), Reaffirmed 2021
e) Los Angeles Abrasion Test- IS 2386 (Part 5), Reaffirmed 2021
f) Water Absorption of Aggregates- IS 2386 (Part 3), Reaffirmed 2021

II TEST ON BITUMEN

a) Specific Gravity of Bitumen-IS 1202: 2021
b) Penetration Test- IS 1203: 2022
c) Viscosity Test-IS 1206 (Part 1): 2023, IS 1206 (Part 2): 2022, IS 1206 (Part 3): 2021
d) Softening Point Test-IS 1205: 2022
e) Ductility-IS 1208 (Part 1) :2023

UNIT IV DESIGN OF RIGID PAVEMENTS 9

Rigid Pavement components and their functions- Factors affecting cement concrete pavements, stresses in rigid pavements: Westergaard's theory, Wheel load stress, Temperature stresses, Frictional stresses, design of joints- dowel bars- tie bars, design of rigid pavement using IRC method

UNIT V HIGHWAY CONSTRUCTION AND MAINTENANCE 18

Construction of subgrade, subbase, base layers, bituminous and cement concrete roads modern materials and methods, Highway drainage - Special considerations for hilly roads; Pavement failures - Types and causes of failures in flexible and rigid pavements. Evaluation and Maintenance of pavements.

PRACTICALS: Test ON BITUMINOUS MIXES – Demonstration classes only.

a) Marshall Stability and Flow Values- ASTM D6927-15
b) Determination of Binder Content- ASTM D 2172

TOTAL: 45L + 60P = 105 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Understand the concepts and standards adopted in Planning, Design and construction of Highways and its related infrastructures
CO2	Apply the knowledge of science and engineering fundamentals in designing the geometrics for an efficient Highway network and design concepts
CO3	Evaluate the properties of the aggregates and bitumen and Apply the knowledge of science and engineering fundamentals in designing flexible pavement. by adopting IRC guidelines
CO4	Design rigid pavements based on design concepts and codal provisions
CO5	Select appropriate methods for construction, evaluation and maintenance of roadways and know about field testing methods

TEXTBOOKS:

1. Veeraragavan. A, Khanna.K and Justo.C.E.G. Highway Engineering, Nem Chand & Bros Publishers, 2014
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010
3. C.Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press `(India) Private Limited, Hyderabad, 2015
4. Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers, 2017.
5. R.Srinivasa Kumar., Textbook of Highway Engineering Universities Press (India) Private Limited, Hyderabad, 2011

REFERENCES:

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2005
2. Kadiyali. L. R. Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 1997.
3. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.
4. Sharma.S.K Principles , Practices and Design of Highway Engineering, S.Chand and Company Ltd.1995
5. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.
6. Khanna.S. K., Justo.C.E.G and Veeraragavan A. “Highway Materials and Pavement Testing”, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
7. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition, 1997, Lexington, KY, USA.

CO-PO & PSO MAPPING: HIGHWAY ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	2	2	2	1	1	2	2	3	2	2
2	3	3	3	2	2	2	1	2	2	2	2	2	3	3	3
3	3	3	3	2	2	2	1	1	1	2	2	2	2	3	3
4	3	3	3	2	2	2	2	1	2	2	2	2	2	3	3
5	2	2	2	3	2	2	2	2	3	2	2	2	3	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23405 WASTEWATER ENGINEERING L T P C
3 0 2 4

UNIT I PLANNING AND DESIGN OF SEWERAGE SYSTEM 9+6

Characteristics and composition of sewage-- population equivalent -Sanitary sewage flow estimation – Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design - Storm runoff estimation – sewer appurtenances – sewage pumping-drainage in buildings-plumbing systems for drainage- Discharge standards for Effluents.

Practicals:

Estimation of suspended, volatile and fixed solids - IS 3025 (Part 18) -1984 R(2012)

UNIT II PRIMARY TREATMENT OF SEWAGE 9+6

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

Practicals:

Determination of Sludge Volume Index in Activated sludge process -Standard Methods for the Examination of Water and Wastewater. 24th ed. Washington DC: APHA Press; 2023.

UNIT III SECONDARY TREATMENT OF SEWAGE 9+6

Objectives – Selection of Treatment Methods – Principles, Functions - Activated Sludge Process and Extended aeration systems –Rotating biological contactors, Trickling filters -Waste Stabilization Ponds – Operation and Maintenance.

Practicals:

Determination of Dissolved Oxygen - IS 3025(Part 38):3025
Estimation of Biochemical Oxygen Demand -IS 3025(Part 44): 1993
Estimation of Chemical Oxygen Demand -IS 3025(Part 58):2006

UNIT IV ADVANCES IN SEWAGE TREATMENT 9+6

Sequencing Batch Reactor – Moving bed biofilm reactor-Membrane Bioreactor - UASB - Biogas recovery- Reclamation and Reuse of sewage – Constructed Wetland –Nutrient removal systems.

Practicals:

Determination of TKN in wastewater - EPA-821-R-01-004-2001
Determination of Ammoniacal Nitrogen in wastewater- IS 3025(Part 34):1988 R(2003)

UNIT V SEWAGE DISPOSAL AND SLUDGE MANAGEMENT 9+6

Dilution – Self purification of surface water bodies Oxygen sag curve – deoxygenation and reaeration - Land disposal – Sewage farming – sodium hazards - Soil dispersion system- Sludge treatment- Objectives - Sludge characterization – Sludge Thickening – Dewatering – Drying - ultimate residue disposal – Septage Management.

Practicals:

Determination of total phosphate in wastewater - IS : 3025 (Part 31) - 1988 R(2003)

TOTAL: 45L + 30P = 75 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1	Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations
CO2	Select type of treatment system and able to perform basic design of the unit operations that are used in sewage treatment
CO3	Gain knowledge of selection of treatment process and biological treatment process
CO4	Acquire knowledge of advance treatment technology and reuse of sewage
CO5	Understand the self-purification of streams and sludge and septage management.

TEXTBOOKS:

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.
2. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.
3. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

REFERENCES:

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim "Wastewater Treatment Plants"*Planning, Design, and Operation, Second Edition* CRC Press, Washington D.C.,2017
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.
5. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington, 2012.
6. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist,H. – Second Edition, VCH, Germany, 3rd Edition, 1999.

CO-PO & PSO MAPPING: WASTEWATER ENGINEERING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	2	3	-	3	3	-	-	1	3	-	-	3	3
2	3	-	3	2	2	3	3	-	2	-	-	-	3	3	3
3	3	-	3	2	-	-	3	-	2	-	-	-	3	2	3
4	2	-	3	2	3	-	3	-	-	-	2	3	3	2	3
5	2	2	3	2	2	3	3	3	-	-	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

CE23U01 **STANDARDS - CIVIL ENGINEERING** **L T P C**
1 0 0 1

MODULE I – OVERVIEW OF STANDARDS **6**

Basic concepts of standardization; Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization. Important Indian and International Standards.

MODULE II – CIVIL ENGINEERING STANDARDS **9**

Structural Engineering:
National Building Code of India (2016)
IS 875 (1-5) - (1987): Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures
IS 800-2007: General Construction using Hot Rolled Steel Sections
IS 456: 2000 (Reaffirmed 2021) Code of practice: Plain and Reinforced Concrete Design
IS 1893 (Part 1) :2016 Code of Practice: Criteria for Earthquake Resistant Design of Structures-General Provisions and Buildings
IS 13920 (Part 1):2016 (Reaffirmed 2021) Code of Practice: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
IS 1343 (2012): Code of Practice for Prestressed Concrete

Soil Mechanics and Foundation Engineering:
Soil Engineering Terms (IS2809) - Soil Testing and Characterization (IS 2720) – Soil Identification and Classification (IS1498) – Subsurface Exploration (IS 1892) – Field Testing for Bearing Capacity (IS2131, IS4968, IS1888) - General Requirements of Foundations (IS1904) – Bearing Capacity of Shallow Foundations (IS 6403) – Settlement of Foundation (IS 8009) – Pile Foundations (IS2911) – Raft Foundations (IS2650).

Transportation Engineering:
Road safety Audit (IRC:SP-88- 2019) –Pedestrian Facilities(IRC:103-2022) - Parking Facilities (IRC:SP:12- 2015) - Cycle track (IRC 11.2015) Indo- Highway Capacity Manual- Case Studies.

Water Resources Engineering:
IS 4986:2002: Installation of Raingauge (Non-Recording Type) and Measurement of Rain and Code of Practice
IS 15797 : 2008 Roof top rainwater harvesting
IS 15896 : 2011 : 2005 Manual methods for measurement of groundwater level in a well
IS 15792 : 2008 code guide lines for Artificial recharge to groundwater IS 7113 : 2003 Code of practice for Soil – Cement lining for canals

Environmental Engineering:
BIS – Drinking water specifications(IS:10500)
National Ambient Air Quality Standards
Minimal National Standards (MINAS) for Industry
Noise limits for vehicles
Airport Noise Notification dated 18 July,2018

UC23U01 **UNIVERSAL HUMAN VALUES** **L T P C**

1 0 2 2

COURSE OBJECTIVE:

The objective of the course is four-fold:

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

Module I: Introduction **(3L,6P)**

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

Practical Session: *Include sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking*

Module II: Harmony in the Human Being **(3L,6P)**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

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

Module III: Harmony in the Family and Society **(3L,6P)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

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

Module IV: Harmony in the Nature and Existence (3L,6P)

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

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

Module V: Implications of Harmony on Professional Ethics (3L,6P)

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

Practical Session: *Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.*

TOTAL: 45 (15 Lectures + 30 Practicals) PERIODS

COURSE OUTCOME:

By the end of the course, the students will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

REFERENCES:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.

7. Slow is Beautiful - Cecile Andrews.
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

Web URLs:

1. Class preparations: https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	1	1	3			3
CO2						1	1	1	3			3
CO3						3	3	2	3		1	3
CO4						3	3	2	3		1	3
CO5						3	3	3	3		2	3

SEMESTER V

CE23501 STRUCTURAL ANALYSIS - I L T P C
3 0 0 3

UNIT I SLOPE DEFLECTION METHOD 9

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

UNIT II MOMENT DISTRIBUTION METHOD 9

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

UNIT III FLEXIBLITY METHOD 9

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

UNIT IV STIFFNESS METHOD 9

Restrained structure - Formation of stiffness matrices - Equilibrium condition - Analysis of continuous beams, pin-jointed plane frames and rigid frames by direct stiffness method.

UNIT V APPROXIMATE ANALYSIS OF FRAMES 9

Approximate analysis for gravity loadings - Substitute frame method for maximum moments in beams and columns - Approximate analysis for horizontal loads - Portal method and cantilever method - Assumptions - Axial force, shearing force and bending moment diagrams.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Analyze the continuous beams and rigid frames by slope defection method
CO2 Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway
CO3 Analyze the indeterminate pin jointed plane frames, continuous beams and rigid frames using direct flexibility method
CO4 Understand the concept of direct stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames
CO5 Analyze the rigid frames by approximate methods for gravity and horizontal loads

TEXTBOOKS:

1. Bhavikatti S. S., “Structural Analysis Vol. 2”, Vikas Publishing House Pvt. Ltd., New Delhi, 2016.
2. Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.

REFERENCES:

1. Punmia B. C., Ashok Kumar Jain & Arun Kumar Jain, “Theory of structures (SMTS 2)”, Laxmi Publications, New Delhi, 2017.
2. Hibbeler R. C., “Structural Analysis”, VII Edition, Prentice Hall, 2012.
3. Bhavikatti S. S., “Matrix Methods of Structural Analysis”, I.K. International Publishing House Pvt. Ltd., New Delhi, 2014.
4. Vaidyanathan R., Perumal P. & Abdul Aleem M. I., “Structural Analysis, Vol. 3”, Laxmi Publications, New Delhi, 2020.

5. Negi L. S. and Jangid R. S., “Structural Analysis”, Tata McGraw Hill Publishing Co. Ltd., 2004.

CO-PO & PSO MAPPING: STRUCTURAL ANALYSIS - I

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23502 DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES L T P C
3 0 0 3

UNIT I DESIGN CONCEPTS AND DESIGN OF BEAMS FOR FLEXURE 9

Design concepts - Concept of elastic method, ultimate load method and limit state method - Advantages of limit state method over other methods - Design of rectangular beam section by working stress method - Limit state method of design of singly reinforced, doubly reinforced and flanged beams - Use of design aids for flexure.

UNIT II LIMIT STATE DESIGN OF BEAMS FOR SHEAR, TORSION AND SERVICEABILITY 9

Limit state design of RC beams for shear and torsion - Design of RC beams for combined bending, shear and torsion - Use of design aids - Design requirement for bond and anchorage as per IS code - Detailing of reinforcement - Concept of serviceability - Serviceability requirements for deflection.

UNIT III LIMIT STATE DESIGN OF SLABS AND STAIRCASE 9

Behaviour of one way and two-way slabs - Design of one way simply supported, cantilever and continuous slabs - Design of two-way slabs for various edge conditions - Torsion reinforcement at corners - Design of flat slabs - Types of staircases - Design of dog-legged staircase.

UNIT IV LIMIT STATE DESIGN OF COLUMNS AND FOOTING 9

Types of columns - Design of short columns for axial load, combined axial load with uniaxial and biaxial bending - Use of design aids - Design of footing for masonry and reinforced walls - Design of axially and eccentrically loaded square and rectangular footings - Design of combined rectangular footings for two columns.

UNIT V DESIGN OF MISCELLANEOUS STRUCTURES 9

Design of cantilever retaining wall, RC water tanks and single-story RC building frame - Introduction to computer-aided RC design (Demo only).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the various design concepts and design a beam under flexure and draw the reinforcement details
CO2 Design the beam under shear and torsion, calculate the anchorage and development length and check the serviceability requirements for RC structural elements
CO3 Design a RC slab and staircase and draw the reinforcement details
CO4 Design short columns and strip, isolated and combined footings, and draw the reinforcement details
CO5 Design a retaining wall, water tank and a framed RC building and draw the reinforcement details

TEXT BOOKS:

1. Gambhir M. L., “Fundamentals of Reinforced Concrete Design”, McGraw Hill Education India Pvt. Limited, 2017.
2. Sinha S. N., “Reinforced Concrete Design”, Tata McGraw-Hill, New Delhi, 2002.

REFERENCES:

1. Unnikrishnan Pillai and Devdas Menon, “Reinforced Concrete Design”, Third Edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.
2. Subramanian N., “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2014.
3. Varghese P. C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India Pvt. Ltd., New Delhi, Second Edition, 2008.

4. Punmia B. C., Ashok K. Jain and Arun K. Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publications (P) Ltd., New Delhi, 2016.

IS CODES

1. IS 456: 2000, “Plain and Reinforced Concrete - Code of Practice”.
2. IS 875 (1-5): 1987, “Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures”.
3. SP 16: 1980, “Design Aids for Reinforced Concrete to IS 456:1978”.
4. SP 34: 1987, “Handbook of concrete reinforcement and detailing”.
5. National Building Code of India 2016 (NBC 2016).

CO-PO & PSO MAPPING: DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	3	2	2	3	2	1	3	3	3	3
2	3	3	3	3	2	3	2	2	3	2	1	3	3	2	3
3	3	3	3	3	2	3	2	2	3	2	1	3	3	3	3
4	3	3	3	3	2	3	2	2	3	2	1	3	3	2	3
5	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23503 FOUNDATION ENGINEERING L T P C
3 0 0 3

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Scope and objectives - Methods of exploration - Auguring and boring - Wash boring and rotary drilling - Depth and spacing of bore holes - Soil samples (Representative and undisturbed) - Sampling methods - Split spoon sampler, Thin wall sampler, Stationary piston sampler - Penetration tests (SPT and SCPT) - Data interpretation - Selection of foundation based on soil condition - Bore log report.

UNIT II SHALLOW FOUNDATION 9

Introduction - Location and depth of foundation - Codal provisions - Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi's formula and BIS formula - Factors affecting bearing capacity - 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 - Codal provision - Methods of minimizing total and differential settlements.

UNIT III FOOTINGS AND RAFTS 9

Types of Isolated footing, Combined footing, Mat foundation - Contact pressure and settlement distribution - Proportioning of foundations for conventional rigid behaviour - Minimum depth for rigid behaviour - Applications - Floating foundation - Codal provision.

UNIT IV PILE FOUNDATION 9

Types of piles and their functions - 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 insitu tests (SPT, SCPT) - Negative skin friction - Uplift capacity - Group capacity by different methods (Feld's rule, Converse - Labarra formula and block failure criterion) - Settlement of pile groups - Interpretation of pile load test (routine test only), Under reamed piles - Capacity under compression and uplift - Codal provision.

UNITV RETAINING WALLS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation

CO2 Determine the bearing capacity and settlement of shallow foundations as per the codal provisions

CO3 Proportion isolated, combined footings and raft foundations, its component or process as per the needs and specifications

CO4 Evaluate the load carrying capacity and settlement of deep foundations as per the codal provisions

CO5 Analyse the stability of retaining walls by considering the plastic equilibrium of soils

TEXTBOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2015.

2. Gopal Ranjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi,2006.

REFERENCES:

1. Das, B.M. “Principles of Foundation Engineering” (Eighth edition), Thompson Asia Pvt. Ltd., Singapore, 2013.
2. Kaniraj, S.R. “Design aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
3. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005.
4. Punmia, B.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd., New Delhi, 2005.

CO-PO & PSO MAPPING: FOUNDATION ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	2	2	3	3	3	2	2	2	2	3	3	3	3
2	3	2	3	2	3	2	3	2	2	2	2	3	3	2	2
3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
4	2	3	3	2	2	2	2	2	2	2	2	3	3	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23504 ENVIRONMENTAL ENGINEERING DRAWING L T P C
0 0 2 1

1 . WATER SUPPLY AND TREATMENT 10

Design and Drawing of flash mixer, clariflocculator - Rapid sand filter - Pressure sand filter- Service reservoirs - House service connection for water supply and drainage.

2. SEWAGE TREATMENT & DISPOSAL 15

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process - Sequencing Batch reactor - Trickling filter - Waste stabilization ponds - Anaerobic sludge digester - Sludge drying beds - Septic tanks and disposal arrangements.

3. BUILDING SERVICES 5

Layout of water supply system in a house-Layout of simple drainage systems for small buildings, apartments and commercial buildings.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1	Design and draw various units of water treatment plants
CO2	Understand and prepare water supply and drainage in buildings
CO3	Design and draw various units of conventional sewage treatment plants
CO4	Design and draw various units of advanced sewage treatment plants
CO5	Design and draw various units of sludge treatment facilities of STP

TEXTBOOKS:

1. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
2. Manual on “Sewerage and Sewage Treatment Systems- Part A, B and C” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.

REFERENCES:

1. Peary, H.S., ROWE, D.R., Tchobanoglous, G., “Environmental Engineering”, McGraw- Hill Book Co., New Delhi, 1995.
2. Metcalf and Eddy, “Wastewater Engineering, Treatment and Reuse”, Tata McGraw-Hill, New Delhi, 2010.
3. Qasim,S.R., Motley, E.M and Zhu.G. "Water works Engineering - Planning, Design and Operation", Prentice Hall, New Delhi, 2009.
4. Qasim, S. R. "Wastewater Treatment Plants, Planning, Design & Operation", CRC Press, New York, 2010.

CO-PO & PSO MAPPING: ENVIRONMENTAL ENGINEERING DRAWING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	1	1	2	1	2	2	1	1	1	3	1	2	2
2	1	1	1	1	1	2	2	2	1	1	2	3	2	2	2
3	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
4	-	3	3	3	3	2	2	3	3	2	3	2	3	3	3
5	2	3	3	3	3	2	2	3	2	2	2	3	2	2	2
Avg.	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23U02 PERSPECTIVES OF SUSTAINABLE DEVELOPMENT L T P C
2 0 2 3

Objective:

- To introduce to the students the concept of sustainability, different types of sustainability, perspectives of sustainable developments, sustainable development goals, engineering for sustainable development and sustainability practices.

MODULE I –INTRODUCTION 6

Principles & Historical perspectives, Importance and need for sustainability in engineering and technology, impact and implications. United Nations Sustainability Development Goals (SDG), UN summit – Rio & outcome, Sustainability and development indicators.

MODULE II – ENVIRONMENTAL SUSTAINABILITY 6

Climate change, Biodiversity loss, Pollution and waste management, Renewable vs. non-renewable resources, Water and energy conservation, Sustainable agriculture and forestry. National and international policies, Environmental regulations and compliance, Ecological Footprint Analysis

MODULE III – SOCIAL & ECONOMIC SUSTAINABILITY 9

Equity and justice, Community development, Smart cities and sustainable infrastructure, Cultural heritage and sustainability, Ethical considerations in sustainable development.

Triple bottom line approach, Sustainable economic growth, Corporate social responsibility (CSR), Green marketing and sustainable product design, Circular economy and waste minimization, Green accounting and sustainability reporting.

MODULE IV – ENGINEERING FOR SUSTAINABLE DEVELOPMENT 9

Engineering for mitigating the impact of climate change and advancement in sustainable development, Perspectives in India and Small Island Developing States (SIDS), Implications of the automation in the manufacturing of building and construction materials and modern construction practices for the sustainable development.

Manufacturing of Green cement and sustainable building materials, decarbonization and Carbon Capture Utilization for the cement industry, buildability and constructability analysis of green and energy efficient buildings and infrastructure, sustainable practices in the water and waste water treatment processes. Application of Design thinking for civil engineering projects to enhance sustainability.

MODULE V – SUSTAINABILITY PRACTICES 30

- Design for Energy Efficiency – Embodied Energy Calculations within the Life Cycle Analysis of Residential Buildings, and Determining thermal comfort of the building using Psychrometric chart.
- Energy efficient building design– Calculation of overall thermal transmittance, Estimation of building energy loads.

- Chemical use and storage – The choice of chemicals being procured, transport and fate of different chemical, the safe disposal of leftover chemicals, the impact of chemicals on the environment and long-term health impacts on humans.
- Green building, green building materials, green building certification and rating: Green Rating for Integrated Habitat Assessment (GRIHA), Leadership in Energy and Environmental Design (LEED) India.
- Tools for Sustainability - Environmental Management System (EMS), ISO14000, Life Cycle Assessment (LCA).
- Ecological footprint assessment using the Global Footprint Network spreadsheet calculator.
- National/Sub-National Status of UN 17 Sustainable Development Goals (SDGs).
- Calculating the sustainability of products based on metrics such as Performance-weighted Environmental Sustainability (PwES) and Planetary Boundary Layers (PBLs).
- 3D modelling for buildability and Constructability analysis of green buildingwith energy auditing strategies.
- Software applications for assessing environmental sustainability for manufacturing processes.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1	**:**	To understand the historical perspective of sustainability, UN Sustainability Development Goals& Sustainability summits, and significance of sustainability in engineering and technology, and its impact and implications.
CO2	**:**	To comprehend the knowledge on environmental sustainability, Environmental regulations and compliance and Ecological Footprint Analysis.
CO3	**:**	To understand the core concepts of social and economic sustainability, circular economy and ethical considerations in sustainable development.
CO4	**:**	To comprehend the knowledge on applications of engineering in sustainable development. Emphasis onthe manufacturing of sustainable building materials, Decarbonization and Carbon Capture Utilization for the cement industry, BIM Modeling and Geographic Information Systems (GIS) for Civil Engineering applications.
CO5	**:**	To understand and perceive the holistic sustainable practices concerning sustainable development.

REFERENCES:

1. Allen, D., & Shonnard, D. R. (2011). Sustainable engineering: Concepts, design and case studies. Prentice Hall.

2. Munier, N. (2005). Introduction to sustainability (pp. 3558-6). Amsterdam, The Netherlands: Springer.

3. Blackburn, W. R. (2012). The sustainability handbook: The complete management guide to achieving social, economic and environmental responsibility. Routledge.

4. Clini, C., Musu, I., & Gullino, M. L. (2008). Sustainable development and environmental management. Published by Springer, PO Box, 17, 3300.

5. Bennett, M., James, P., & Klinkers, L. (Eds.). (2017). Sustainable measures: Evaluation and reporting of environmental and social performance. Routledge.

6. Seliger, G. (2012). Sustainable manufacturing for global value creation (pp. 3-8). Springer Berlin Heidelberg.

7. Stark, R., Seliger, G., & Bonvoisin, J. (2017). Sustainable manufacturing: Challenges, solutions and implementation perspectives. Springer Nature.

8. Davim, J. P. (Ed.). (2013). Sustainable manufacturing. John Wiley & Sons.

9. Tam, V. W.Y., Le, K. N. (2019). SustainableConstruction Technologies:Life-Cycle Assessment. Elsevier Science, Netherlands.

CO-PO & PSO Mapping: PERSPECTIVES OF SUSTAINABLE DEVELOPMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1	1	1	1	1	3	2	3	1	2	1	1	1
2	2	1	2	1	1	1	1	3	2	3	1	2	1	1	1
3	3	2	2	2	1	1	1	3	3	3	3	3	2	2	2
4	3	2	3	2	3	1	1	3	2	3	1	3	3	3	3
5	3	3	3	3	3	3	1	3	2	3	3	3	3	3	3
Avg.	3	2	2	2	2	1	1	3	2	3	2	3	2	2	2

‘1’ = Low; ‘2’ = Medium; ‘3’ = High

SEMESTER VI

CE23601 STRUCTURAL ANALYSIS - II L T P C
3 0 0 3

UNIT I INFLUENCE LINES FOR DETERMINATE STRUCTURES 9

Influence lines for reactions in statically determinate structures - Influence lines for shear force and bending moment in beam sections - Calculation of critical stress resultants due to concentrated and distributed moving loads - Influence lines for member forces in pin-jointed plane frames.

UNIT II INFLUENCE LINES FOR INDETERMINATE BEAMS 9

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

UNIT III ARCHES 9

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

UNIT IV SUSPENSION BRIDGES 9

Equilibrium of cable - Length of cable - Anchorage of suspension cables - Stiffening girders - Cables with three-hinged stiffening girders - Influence lines for three-hinged stiffening girders.

UNIT V PLASTIC ANALYSIS 9

Basis of plastic analysis and design - Material behavior - Cross-section behavior - Plastic moment of resistance - Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - Static and kinematic methods - Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Draw influence lines for various stress functions for determinate beams and plane trusses
CO2 Gain knowledge in drawing influence lines for determinate beams
CO3 Analyze three-hinged, two-hinged and fixed arches
CO4 Explain the load transfer mechanism in suspension cables and the purpose of stiffening girders
CO5 Explore the basis of plastic analysis and design of structures

TEXTBOOKS:

1. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of structures (SMTS 2)", Laxmi Publications, 2004.
2. Vaidyanathan R. and Perumal P., "Structural Analysis, Vol. 2", Laxmi Publications, 2017.

REFERENCES:

1. Negi L. S. and Jangid R. S., "Structural Analysis", Tata McGraw-Hill Publishers, 2004.
2. Vazrani V. N. and Ratwani M. M., "Analysis of Structures, Vol.II", Khanna Publishers, 2015.
3. Gambhir M. L., "Fundamentals of Structural Mechanics and Analysis", PHIL earning Pvt. Ltd., 2011.
4. Ramamrutham S. and Narayanan R., "Theory of Structures", Dhanpat Rai Publishing Company, New Delhi, 2019.

CO-PO & PSO MAPPING: STRUCTURAL ANALYSIS - II

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23602 DESIGN OF STEEL STRUCTURES L T P C
3 0 0 3

UNIT I INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS 9
General - Types of steel - Properties of structural steel - I. S. rolled sections - Concept of limit state design - Design of simple and eccentric bolted and welded connections - Efficiency of joint - Prying action - Design of HSFG bolts - IS 800: 2007.

UNIT II TENSION MEMBERS 9
Behavior and design of simple and built-up members subjected to tension - Shear lag effect - Design of lug angles - Tension splice.

UNIT III FLEXURAL MEMBERS 9
Design of laterally supported and unsupported beams - Design of built-up beams - Design of plate girders.

UNIT IV COMPRESSION MEMBERS 9
Design of simple and built-up compression members with lacings and battens - Design of column bases - Slab base and gusseted base.

UNIT V INDUSTRIAL STRUCTURES 9
Design of roof trusses - Loads on trusses - Purlin design using angle and channel sections - Truss design - Design of joints and end bearings - Design of gantry girder - Introduction to pre-engineered buildings.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the student is expected to be able to:

CO1 Identify the different failure modes of bolted and welded connections, and to determine their design strengths
CO2 Select the most suitable section shape and size for tension members as per specific design criteria
CO3 Design laterally supported and unsupported beams
CO4 Select the most suitable section shape and size for compression members according to specific design criteria
CO5 Identify and compute the design loads on Industrial structures, and gantry girder

TEXT BOOKS:

1. Gambhir M. L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013.
2. Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
3. Duggal S. K., "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2005.

REFERENCES:

1. Narayanan R. et. al., "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publications, 2002.
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. Shah V. L. and Veena Gore, "Limit State Design of Steel Structures", IS: 800 - 2007, Structures Publications, 2009.

4. IS 800: 2007, “General Construction in Steel - Code of Practice”, Third Revision, Bureau of Indian Standards, New Delhi, 2007.
5. Sai Ram K. S., “Design of Steel Structures”, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015, www.pearsoned.co.in/kssairam.
6. Shiyekar M. R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2013.

CO-PO & PSO MAPPING: DESIGN OF STEEL STRUCTURES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	2	2	1	1	1	1	1	1	1	3	3	3
2	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
3	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
4	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
5	3	3	2	2	2	1	1	1	1	1	1	1	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23603 **BUILDING AND STRUCTURAL DRAWING** **LT P C**
0 0 4 2

LIST OF EXPERIMENTS (manual and computer-based:

1. Principles of planning and orientation
2. Buildings with load bearing walls and RCC roof (Plan, section, elevation)
3. Buildings with sloping roof
4. Buildings with framed structures
5. Reinforcement details of RCC structural elements (slab, beam and column with footings)
6. Reinforcement details of RCC cantilever retaining wall and circular water tank
7. Steel structures (steel connections detailing, beam-to-column connection, beam-to-beam connection)
8. Industrial structures - steel roof truss, purlin, column base connections and plate girders

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Draft the plan, elevation and sectional view of the load bearing and framed buildings
CO2 Draw the structural detailing of RCC elements
CO3 Draw the structural detailing of RCC water tanks, footings and retaining walls
CO4 Draw the structural detailing of steel structures
CO5 Draft the structural detailing of industrial structures

REFERENCES:

1. V. B. Sikka, “A course in Civil Engineering Drawing”, S. K. Kataria & Sons Publishers, Seventh Edition, 2015.
2. D. N. Ghose, “Civil Engineering Drawing and Design”, CBS Publishers & Distributors Pvt. Ltd., 2nd Edition, 2010.
3. National Building Code of India 2016 (NBC 2016).
4. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Third Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.
5. Subramanian N., “Design of Steel Structures”, Oxford University Press, New Delhi, 2016.

CO-PO & PSO MAPPING: BUILDING AND STRUCTURAL DRAWING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	3	2	1	1	2	2	1	2	3	2	2
2	3	2	3	2	2	2	1	1	2	2	1	2	3	3	3
3	3	3	3	2	3	3	2	1	2	2	1	2	3	3	2
4	3	3	2	2	2	3	2	1	2	2	1	2	3	2	3
5	3	2	3	3	3	2	2	1	2	2	1	2	2	2	3
Avg.	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

UC23E01 ENGINEERING ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

1. Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2. Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

MODULE – I: ENTREPRENEURIAL MINDSET **4L,8P**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economies – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

MODULE – II: OPPORTUNITIES **4L,8P**

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

MODULE – III: PROTOTYPING & ITERATION **4L,8P**

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

MODULE – IV: BUSINESS MODELS & PITCHING **4L,8P**

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest Assumptions in Business Model Design – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

MODULE – V: ENTREPRENEURIAL ECOSYSTEM **4L,8P**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types

CO2: Comprehend the process of opportunity identification through design thinking, identify market potential and customers

CO3: Generate and develop creative ideas through ideation techniques

CO4: Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP

CO5: Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

REFERENCES:

1 Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition

2. Bill Aulet (2024). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons.

3. Bill Aulet (2017). Disciplined Entrepreneurship Workbook. John Wiley & Sons.

4. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business

5. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch

6. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons

7. Marc Gruber & Sharon Tal (2019). Where to Play: 3 Steps for Discovering Your Most Valuable Market Opportunities. Pearson.

SEMESTER VII

CE23701 IRRIGATION ENGINEERING L T P C
3 0 2 4

UNIT I IRRIGATION PRINCIPLES 9

Need for irrigation - Advantages and ill effects - Development of irrigation - National Water Policy - Tamil Nadu scenario – Soil-Water-Plant relationship: Soil classification, Field capacity, permanent and temporary wilting point - Physical properties of soil that influence soil moisture characteristics - Concept of soil water potential and its components: Gravitational and Osmotic pressures - Retention of water in soils - Concept of available water - Movement of water into and within the soils - Measurement of soil moisture content.

UNIT II CROP WATER REQUIREMENT 9

Necessity and importance - Crop and crop seasons in India - Duty, Delta, Base Period - Factors affecting Duty - Irrigation efficiencies - Consumptive use of water -Irrigation requirements of crops - Irrigation scheduling: CROPWAT - Standards for irrigation water - Planning and Development of irrigation projects.

UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9 + 15

Purpose and components of diversion Head works - Weirs and Barrages - Types of impounding structures - Factors affecting, location of dams -Forces on a dam - Design of Gravity dams; Earth dams, Arch dams - Spillways - Energy dissipaters.

PRACTICALS:

TANK COMPONENTS: Fundamentals of design - Tank surplus weir - Tank sluice with tower head - Drawings showing foundation details, plan and elevation.

CONSERVATION STRUCTURES**:** Design principles - Check dam - Drawings showing foundation details, plan and elevation.

UNIT IV CANAL IRRIGATION 9 + 15

Classification of canals - Alignment of canals - Design of irrigation canals - Regime theories: Kennedy's theory, Lacey's theory - Canal Head works - Canal regulators - Canal drops - Cross drainage works - Canal Outlets, Escapes - Lining and maintenance of canals - Other methods of Irrigation: Surface, Subsurface - Merits and Demerits - Micro irrigation - Sprinkler and Drip - Irrigation scheduling using artificial intelligence.

PRACTICALS:

CANAL REGULATION STRUCTURES: General Principles - Canal drop (Notch Type) - Canal Regulator - Drawings showing detailed plan, elevation and foundation details.

CROSS DRAINAGE WORKS: General design principles – Aqueducts - Syphon aqueduct (Type-III) -- Drawings showing plan, elevation and foundation details.

UNIT V IRRIGATION WATER MANAGEMENT 9

Modernization techniques - Rehabilitation - Command Area Development - Systems of rice/millets intensification - Water delivery systems - Participatory Irrigation Management - Farmers' organization and turn over - Water Users' Associations - Economic aspects of irrigation.

TOTAL: 45L + 30P = 75 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to:

CO1 Understand the basics of soil-plant-water characteristics and the National Water Policy
CO2 Estimate the crop water requirement, after understanding the basics
CO3 Discuss the various types of hydraulic structures including dams, spillways and energy dissipaters, design the irrigation tank components and the conservation structures
CO4 Design the irrigation canal, detail the canal drops and cross drainage works and to discuss on the various irrigation methods, design the canal regulation structures and the cross-drainage works
CO5 Apply the concepts of Irrigation water management, Water Users' Association for participatory irrigation management

TEXTBOOKS:

1. R.K. Sharma and T.K. Sharma, "Irrigation Engineering", S. Chand and Company, New Delhi, 2008.
2. S.K. Garg, "Irrigation Engineering", Laxmi Publications, New Delhi, 2008.
3. Satya Narayana Murthy Chala, "Water Resources Engineering: Principles and Practice", New Age International Publishers, New Delhi, 2002.
4.. S.K. Garg, "Irrigation Engineering and Design of Structures", New Age International Publishers, New Delhi, 1997.

REFERENCES:

1. C.S.N. Murthy, Water Resources Engineering - Principles and Practice, 2nd Edition, New Age International Publishers, 2020.
2. K.R. Arora, Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributors, New Delhi, 2009.
3. N.N. Basak, Irrigation Engineering, Tata McGraw-Hill Publishing Co, New Delhi, 2008.
4. Dilip Kumar Majumdar, Irrigation Water Management, Prentice-Hall of India, New Delhi, 2008.
5. B.C. Punmia, Irrigation and Water Power Engineering, Laxmi Publishers, New Delhi, 2008.
6. Mohana Krishnan, A few Novel and Interesting Innovative Irrigation Structures: Conceived, Designed and Executed in the Plan Projects in Tamil Nādu, Publ.No. 44 and Water Resources Development & Management Publ.No.43, IMTI Thuvakudy, Trichy, 2011.
7. H.M. Raghunath, Irrigation Engineering, Wiley India Pvt. Ltd., New Delhi, 2011.
8. R.K. Sharma, Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi, 2002.

CO-PO & PSO MAPPING: IRRIGATION ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1
2	1	1	1	1	2	2	1	1	1	2	1	2	3	2	2
3	2	3	3	2	1	1	2	2	1	1	1	2	3	2	2
4	2	3	3	1	1	1	2	2	1	1	1	2	3	2	2
5	1	1	1	2	1	2	2	2	2	2	2	2	3	2	2
Avg.	**1**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**

CE23702 ESTIMATION, COSTING AND VALUATION ENGINEERING L T P C
3 0 0 3

UNIT I QUANTITY ESTIMATION 9

Philosophy - Purpose - Methods of estimation - Types of estimates - Approximate estimates - Detailed estimate - Estimation of quantities for buildings, roads, canals and hydraulic structures - Building approval process.

UNIT II RATE ANALYSIS AND COSTING 9

Standard data - Observed data - Schedule of rates - Market rates - Assessment of man hours and machineries for common civil works - Rate analysis.

UNIT III SPECIFICATIONS, REPORTS AND TENDERS 9

Specifications - Detailed and general specifications - Constructions - Sources - Types of specifications - Principles for report preparation - Report on estimate of residential building - Culvert - Roads - TTT Act 2023 - Tender notices - Types - Tender procedures - Drafting model tenders, E-tendering - Digital signature certificates - Encrypting - Decrypting - Reverse auctions.

UNIT IV CONTRACTS 9

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

UNIT V VALUATION 9

Definitions - Various types of valuations - Valuation methods - Categories of land as per GOI - Valuation of land - Buildings - Valuation of plant and machineries - Calculation of standard rent - Mortgage - Lease - E-service of GOI.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual and software packages
CO2 Acquire the knowledge to calculate rate analysis and man-hours required for the common civil works by manual and software packages
CO3 Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation and report preparation
CO4 Acquire the knowledge of construction contracts and contract document preparation
CO5 Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease

TEXTBOOKS:

1. B. N. Dutta, “Estimating and Costing in Civil Engineering”, CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B. S. Patil, “Civil Engineering Contracts and Estimates”, 7th edition, University Press, 2015.
3. D. N. Banerjee, “Principles and Practices of Valuation”, V Edition, Eastern Law House, 2015.

REFERENCES:

1. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

CO-PO & PSO MAPPING: ESTIMATION, COSTING AND VALUATION ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
3	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
4	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

SEMESTER VIII

CE23801 PROJECT WORK / INTERNSHIP CUM PROJECT WORK L T P C
0 0 16 8

SYLLABUS:

The student works on a topic relevant to civil engineering under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

TOTAL: 240 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify civil engineering problems reviewing available literature
CO2 Identify appropriate techniques to analyze complex civil engineering problems
CO3 Apply engineering and management principles through efficient handling of project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

PROFESSIONAL ELECTIVE COURSES (PEC)

VERTICAL I: STRUCTURES

CE23001 CONCRETE TECHNOLOGY L T P C
3 0 0 3

UNIT I FRESH AND MECHANICAL PROPERTIES 9

Fresh concrete: Workability - Concepts and tests as per Indian codal specifications - Concrete manufacturing stages: Batching - Mixing - Transportation - Placing of concrete - Curing of concrete - Water: Quality of water for mixing and curing - Hardened concrete: Factors affecting strength of concrete - Compressive strength test - Split tensile strength - Flexure test - Modulus of elasticity.

UNIT II ADMIXTURES 9

Admixtures - Types - Natural admixtures - Fly ash - Slag - Metakaolin - Rice husk ash - Micro and nano silica - Mineral additives and fillers - Chemical admixtures: Accelerators - Retarders -Plasticizers and Super plasticizers - Air entraining admixtures - Water proofers - Coloring agent.

UNIT III MIX DESIGN 9

Mix Design - Factors influencing mix proportion - Design mix and nominal mix - Mix design by IS method using IS 10262-2019 - Variability in test results - Quality control - Sampling and acceptance criteria.

UNIT IV SPECIAL CONCRETES AND CONCRETING METHODS 9

Special concretes: Light weight concrete - Fibre reinforced concrete - Polymer concrete - Ferrocement - Ready mix concrete - Self compacting concrete - Geopolymer concrete - High performance concrete. Concrete methods: Extreme weather concreting - Vacuum concrete - Underwater concreting.

UNIT V NON-DESTRUCTIVE TEST AND DURABILITY OF CONCRETE 9

Non-destructive tests: Rebound hammer - Ultra sonic pulse velocity test - Core test - Durability of concrete - Permeability of concrete - Creep and Shrinkage - Plastic shrinkage - Drying shrinkage - Chemical attack - Sulfate attack - Chloride attack - Mechanism of corrosion - Remedial measures - Application of IoT in smart curing system for concrete.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Have thorough knowledge of the fresh and mechanical properties of concrete
CO2 Explain the effect of admixtures on the behaviour of concrete
CO3 Design concrete mix design by IS method and be aware of the acceptance criteria as per code
CO4 Explore the application of special concretes for practical purposes and special concreting methods
CO5 Describe and carry out non-destructive and durability tests on concrete

TEXTBOOKS:

1. Shetty M. S., “Concrete Technology”, Theory & Practice, S. Chand and Co., 2019.
2. Bhavikatti S. S., “Concrete Technology”, I. K. International Publishing House Pvt. Limited, 2015.
3. Gupta.B. L. and Amit Gupta, “Concrete Technology”, Jain Book Agency, 2010.

REFERENCES:

1. Kumar Mehta P., Paulo and Moteiro J. M., “Concrete-Micro Structure, Properties and Materials”, 3rd Edition, Mcgraw Hill, 2006.

2. Santhakumar A. R., “Concrete Technology”, Oxford University Press, New Delhi, 2018.
3. Job Thomas, “Concrete Technology”, Cengage learning India Pvt. Ltd., 2015.
4. Gambhir M. L., “Concrete Technology”, Tata McGraw Hill, 2012.
5. Nevile A. M., “Properties of Concrete”, Longman Publishers, 2008.

CO-PO & PSO MAPPING: CONCRETE TECHNOLOGY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	3	3	2	2	2	2	2	1	2	3	2	2
2	2	2	2	2	2	3	3	2	1	2	1	3	3	2	2
3	3	3	3	3	2	2	1	1	1	2	2	2	2	2	2
4	3	3	2	2	3	2	2	2	2	2	2	3	3	3	3
5	3	3	3	3	3	3	3	2	2	2	2	2	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23002 **PREFABRICATED STRUCTURES** **L T P C**
3 0 0 3

UNIT I INTRODUCTION **10**

Need for prefabrication - Principles - Materials - Modular co-ordination - Standardization - Systems Production - Transportation - Erection - Disuniting of structures.

UNIT II PREFABRICATED COMPONENTS **10**

Behavior of structural components - Large panel constructions - Construction of roof, floor slabs and wall panels - Columns - Shear walls.

UNIT III DESIGN PRINCIPLES **10**

Design of structural components - Beam, column and corbel - Stress limitations - Handling without cracking, handling with controlled cracking - Design for stripping forces.

UNIT IV JOINTS IN STRUCTURAL MEMBERS **8**

Joints for different structural connections - Beam-to-column, beam-to-beam, column-to-column, column-to-foundation - Connections between wall panels - Connections between floor panels - Dimensions and detailing - Design of expansion joints - Jointing materials.

UNIT V DESIGN FOR EARTHQUAKES AND CYCLONES **7**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the principles of modular coordination
CO2 Know the construction of roof and floors
CO3 Design for stripping forces
CO4 Identify the different types of connections between structural members
CO5 Understand the concept of progressive collapse

TEXTBOOKS:

1. Hubert Bachmann and Alfred Steinle, “Precast Concrete Structures”, 2012.
2. Laszlo Mokk, “Prefabricated Concrete for Industrial and Public Structures”, Akademiai Kiado, Budapest, 1964.

REFERENCES:

1. “PCI Design Hand Book”, 6th Edition, 2004.
2. “Handbook on Precast Concrete for Buildings”, ICI Bulletin 02, First Edition, 2016.
3. A. S. G. Bruggeling and G. F. Huyghe, “Prefabrication with concrete”, Netherlands: A. A. Balkema Publishers, 1991.
4. Glover C. W., “Structural Precast Concrete”, Asia Publishing House, 1965.

CO-PO & PSO MAPPING: PREFABRICATED STRUCTURES

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	2	2	3	1	1	1	2	3	2	3
2	3	2	2	2	2	2	2	3	1	1	1	2	3	2	3
3	3	3	3	2	2	2	2	3	1	1	1	2	3	2	3

4	3	3	3	2	2	2	2	3	1	1	1	2	3	2	3
5	3	3	3	2	3	2	2	3	1	1	1	2	3	2	3
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23003 PRESTRESSED CONCRETE STRUCTURES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Historical developments - Advantages over ordinary reinforced concrete - Basic principles of prestressing - Classification and types - Materials - High strength concrete and high tensile steel - Methods of prestressing - Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems - Stress distribution: stress concept, strength concept and load balancing concept - Losses of prestress in post-tensioned and pre-tensioned members.

UNIT II DESIGN FOR FLEXURE AND SHEAR 9

Design of post-tensioned and pre-tensioned beam sections - Influence of layout of cables in post-tensioned beams - Design for shear based on I.S. 1343 code.

UNIT III DEFLECTION AND DESIGN OF ANCHORAGE ZONE 9

Factors influencing deflections - Short-term deflections of uncracked members - Prediction of long-term deflections due to creep and shrinkage - Check for serviceability limit state of deflection - Transmission of prestress - Determination of anchorage zone stresses in post-tensioned beams - Design of anchorage zone reinforcement - Check for transfer bond length in pre-tensioned beams - Design of end zone reinforcement.

UNIT IV COMPOSITE BEAMS AND CONTINUOUS BEAMS 9

Analysis and design of composite beams - Shrinkage strain and its importance - Methods of achieving continuity in continuous beams - Analysis for secondary moments - Concordant cable and linear transformation - Calculation of stresses - Principles of design.

UNIT V MISCELLANEOUS STRUCTURES 9

Prestressed concrete tension members - Pipes, cylindrical water tanks - Prestressed concrete compression members - Piles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Design a prestressed concrete beam accounting for losses
CO2 Design for flexure and shear
CO3 Design the anchorage zone for post tensioned members and deflection in beams
CO4 Design composite members and continuous beams
CO5 Design pipes, water tanks and piles

TEXTBOOKS:

1. Krishna Raju N., “Prestressed Concrete”, Tata McGraw Hill Company, Fifth edition, 2012.
2. Pandit G. S. and Gupta S. P., “Prestressed Concrete”, CBS Publishers and Distributers Pvt. Ltd., Second edition, 2014.

REFERENCES:

1. Lin T. Y. and Ned H. Burns, “Design of Prestressed Concrete Structures”, John Wiley and Sons, Third Edition, 1981.
2. Rajagopalan N., “Prestressed Concrete”, Narosa Publishing House, 2002.
3. Dayaratnam P. and Sarah P., “Prestressed Concrete Structures”, Seventh Edition, Oxford and IBH, 2017.
4. Sinha N. C. and Roy S. K., “Fundamentals of Prestressed Concrete”, S. Chand and Co. Ltd., 2011.

CO-PO & PSO MAPPING: PRESTRESSED CONCRETE STRUCTURES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	2	2	2	2	3	1	1	1	2	3	3	3
2	3	2	3	2	2	2	2	3	1	1	1	2	3	3	3
3	3	3	3	2	3	2	2	3	1	1	1	2	3	3	3
4	3	3	3	3	3	2	2	3	1	1	1	2	3	3	3
5	3	3	3	3	3	2	2	3	1	1	1	2	3	3	3
Avg.	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23004 STRUCTURAL RETROFIT AND REHABILITATION L T P C
3 0 0 3

UNIT I MAINTENANCE AND REPAIR STRATIGES 9

Maintenance, repair and rehabilitation - Facets of maintenance - Importance of maintenance - Various aspects of inspection - Service life behavior - Assessment procedure for evaluating a damaged structure - Causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete - Strength and durability of concrete - Cracks, different types, causes - Effects due to climate, sustained elevated temperature, corrosion - Methods to assess the quality of hardened concrete.

UNIT III SPECIAL CONCRETES 9

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete - High performance concrete - Vacuum concrete - Self compacting concrete - Geopolymer concrete - Reactive powder concrete - Concrete made with industrial wastes.

UNIT IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS 9

Epoxy injection - Shoring - Underpinning - Corrosion protection techniques - Corrosion inhibitors, corrosion resistant steels, coatings to reinforcement, cathodic protection.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Strengthening of structural elements - Repair of structures distressed due to corrosion, fire, leakage and earthquake - Demolition techniques - Engineered demolition methods - Case studies - Restoration of heritage structures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Know the importance of inspection and maintenance
CO2 Study the impacts of cracks, corrosion and climate on structures
CO3 Know about high performance concrete
CO4 Understand the materials and techniques needed for repairs
CO5 Know the failures of the structures and demolition techniques

TEXT BOOKS:

1. Shetty M. S. and Jain A. K., “Concrete Technology - Theory and Practice”, S. Chand and Company, Eighth Edition, 2019.
2. B. Vidivelli, “Rehabilitation of Concrete Structures”, Standard Publishes Distribution, 1st Edition, 2009.

REFERENCES:

1. “Handbook on Seismic Retrofit of Buildings”, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on “Repair and Rehabilitation of RCC Buildings”, Director General works, CPWD, Govt. of India, New Delhi, 2002.
3. P. C. Varghese, “Maintenance, Repair and Rehabilitation & Minor works of building”, Prentice Hall India Pvt. Ltd., 2014.
4. R. Dodge Woodson, “Concrete Structures, Protection, Repair and Rehabilitation”, Butterworth-Heinemann, Elsevier, New Delhi, 2012.

CO-PO & PSO MAPPING: STRUCTURAL RETROFIT AND REHABILITATION

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	-	3	-	-	-	-	2	-	1	-	2	-	-
2	2	2	-	3	-	-	3	2	2	1	-	-	2	-	-
3	-	-	3	-	3	2	-	2	-	-	-	2	-	3	2
4	-	-	2	-	3	3	3	2	-	-	-	2	-	3	3
5	2	-	3	-	2	2	2	-	-	-	-	2	-	2	2
Avg.	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23005 DYNAMICS AND EARTHQUAKE RESISTANT STRUCTURES L T P C
3 0 0 3

UNIT I INTRODUCTION TO DYNAMICS 9

Dynamics - Degree of freedom - Free and forced vibration - Idealization of structure as single degree of freedom (SDOF) and multi degree of freedom (MDOF) system - D' Alembert's principles - Formulation of equation of motion for SDOF system and MDOF system - Evaluation of natural frequencies and modes - Orthogonality principle - Modal superposition method - Response to forced vibrations - Effect of damping.

UNIT II SEISMOLOGY 9

Earthquake phenomenon - Seismo-tectonics - Elastic rebound theory - Seismic waves - Intensity and magnitude - Seismic instrumentation - Strong earthquake motion - Estimation of earthquake parameters - History of earthquakes in India - Seismic zonation of India - Micro-zonation - Liquefaction of soil - Soil-structure interaction - Tsunami - Seismic hazard analysis - Response spectra.

UNIT III EARTHQUAKE EFFECTS ON STRUCTURES 9

Inertia force on structures - Load transfer path - Effect of architectural features on behavior of structures - Hysteretic behaviour of R.C.C., steel and prestressed concrete - Pinching effect - Bauschinger effects - Energy dissipation - P-delta effect - Story drift - Behavior of brick masonry, stone masonry and reinforced concrete structures under past earthquakes - Typical failures - Causes of damage - Lessons learnt from past earthquakes.

UNIT IV ANALYSIS OF STRUCTURES FOR EARTHQUAKE LOAD 9

Design spectra - Codal provision - Evaluation of earthquake forces - Different methods of analysis for earthquake loads - Analysis of structure by equivalent static method - Analysis of structure by response spectrum method - Introduction to time-history method of analysis.

UNIT V EARTHQUAKE RESISTANT DESIGN 9

Philosophy of earthquake resistant design - Planning considerations and architectural concepts - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member - Ductile detailing of beam-column joints and footing - Concept and principle of shear wall - Structural systems for lateral load resistance in building - Seismic isolation principles and methods - Introduction to performance based seismic design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Develop the equations of motion for SDOF and MDOF system and to evaluate the natural frequencies and mode shapes
CO2 Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation
CO3 Explain the behavior of various types of structures under earthquake
CO4 Estimate the forces in a structure and structural elements due to earthquake
CO5 Design earthquake resistant building structures

TEXTBOOKS:

1. Anil K. Chopra, "Dynamics of structures - Theory and Applications to Earthquake Engineering", Prentice Hall Inc., 2007.
2. Mario Paz, "Structural Dynamics - Theory and Computations", Fifth Edition, 2nd Printing, CBS Publishers, 2006.

3. 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”, McGraw Hill Book Company, 1986.
3. Madhujit Mukhopadhyay, “Structural Dynamics: Vibrations and Systems”, ANE Books, 2008.
4. Moorthy C. V. R., “Earthquake Tips”, NICEE, IIT Kanpur, 2002.

Publication of Bureau of Indian Standards:

1. IS 4326: 2013, “Earthquake Resistant Design and Construction of Buildings - Code of Practice”.
2. IS 1893: 2016, “Criteria for Earthquake Resistant Design of Structures - Part 1 - General Provisions and Buildings”.
3. IS 13920: 2016, “Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice”.

CO-PO & PSO MAPPING: DYNAMICS AND EARTHQUAKE RESISTANT STRUCTURES

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	1	1	1	1	1	1	1	3	2	2
2	3	3	3	2	1	1	2	1	1	1	1	2	3	3	2
3	3	3	3	2	1	2	3	2	2	2	1	2	3	3	3
4	3	3	3	3	2	1	1	1	2	2	1	1	3	3	3
5	3	3	3	3	2	2	3	2	2	2	1	2	3	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23006 FINITE ELEMENT METHOD IN CIVIL ENGINEERING L T P C
3 0 0 3

UNIT I 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.

UNIT II STIFFNESS MATRIX FORMULATION 9

Introduction to discrete and continua elements - Direct stiffness method - Special characteristics of stiffness matrix - Assemblage of elements - Boundary condition & reaction - Equilibrium equations - Strain displacement relation - Linear constitutive relation - Stiffness matrix formulation of 2D truss element - 2D beam element - Plane frame element - Numerical methods in finite element analysis - Gauss elimination method.

UNIT III 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 and serendipity elements - Strain displacement matrix - Element stiffness matrix and nodal load vector - Natural frequencies of longitudinal vibration and mode shapes.

UNIT IV 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 V 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

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the basics of finite element formulation
CO2 Formulate the stiffness matrix for beam, truss and framed structures
CO3 Apply finite element formulations to solve one-dimensional problems
CO4 Apply finite element method to solve two dimensional problems
CO5 Apply finite element method to analyze plate bending problems

TEXTBOOKS:

1. Rao S. S., “The Finite Element Method in Engineering”, 6th Edition, Butterworth Heinemann, 2018.
2. Reddy J. N., “Introduction to the Finite Element Method”, 4th Edition, Tata McGraw Hill, 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.
3. G. R. Liu and S. S. Quek, “Finite Element Method: A Practical Course”, Butterworth-Heinemann, 1st edition, 2003.
4. Chennakesava R. Alavala, “Finite Element Methods: Basic Concepts and Applications”, Prentice Hall Inc., 2010.

5. R. T. Chandrupatla and A. D. Belegundu, “Introduction to Finite Elements in Engineering”, PHI Learning Pvt. Ltd., New Delhi, 1997.
6. S. S. Bhavikatti, “Finite Element Analysis”, New Age Publishers, 2007.

CO-PO & PSO MAPPING: FINITE ELEMENT METHOD IN CIVIL ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	3	-	-	3	-	1	1	3	2	2
2	3	3	3	2	1	2	-	-	3	-	1	1	3	2	2
3	3	3	3	2	2	2	-	-	3	-	2	1	3	2	2
4	2	3	3	2	2	2	-	-	3	-	1	2	3	2	2
5	3	3	3	2	3	2	-	-	3	-	1	2	3	2	2
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL II: CONSTRUCTION TECHNIQUES AND PRACTICES

CE23007 CONSTRUCTION EQUIPMENT AND MACHINERY L T P C
3 0 0 3

UNIT I CONSTRUCTION EQUIPMENTS 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 analysis - Safety management.

UNIT II EQUIPMENT FOR EARTHWORK 9

Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders - Dozer, excavators, rippers, loaders, trucks and hauling equipment, compacting equipment, finishing equipment - Case studies on earthwork equipment.

UNIT III OTHER CONSTRUCTION EQUIPMENT 9

Equipment for dredging, trenching, drag line and clamshells, tunneling - Jacking equipment - Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane - Types of pumps used in construction - Equipment for dewatering, grouting and demolition.

UNIT IV ASPHALT AND CONCRETE PLANTS 9

Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment - Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment - Asphalt plant - Asphalt pavers - Asphalt compacting equipment.

UNIT V MATERIALS HANDLING EQUIPMENT 9

Forklifts and related equipment - Portable material bins - Material handling conveyors - Material handling cranes - Industrial trucks - Aerial transporting equipment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Develop knowledge on planning of equipment and selection of equipment
CO2 Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment
CO3 Develop the knowledge on special construction equipment
CO4 Apply the knowledge on asphalt and concrete plants
CO5 Apply the knowledge and select the proper materials handling equipment

TEXTBOOKS:

1. Peurifoy, R.L., Schexnayder, C., Schmitt, R.L. and Aviad Shapira., Construction Planning, Equipment and Methods, 9th Edn. McGraw Hill, Singapore, 2018.
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, 4th Edn. Khanna Publishers, New Delhi, 2020.
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 2018.
3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008.
4. Dr. Mahesh Varma., Construction Equipment and its Planning and Application, Metro-politan Book Company, New Delhi., 2003.

CO-PO & PSO MAPPING: CONSTRUCTION EQUIPMENT AND MACHINERY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	2	2	3	2	2	3	2	2	2	3	2	3
2	3	3	2	2	3	2	2	2	2	2	3	3	2	2	3
3	2	3	2	2	2	3	2	2	3	2	2	2	2	3	2
4	2	2	3	3	2	3	3	2	3	2	2	2	3	2	3
5	3	2	3	2	3	2	3	3	3	2	2	2	2	2	3
Avg.	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23008 CONSTRUCTION PROJECT MANAGEMENT THROUGH LEAN CONCEPTS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT 9

Introduction of construction project management - Construction scope - Construction project characteristics - Project development and life cycle - Construction project management practice - Roles and functions and responsibility of construction managers and major causes of project failure.

UNIT II CONSTRUCTION PLANNING 9

Basic concepts in the development of construction plans - Choice of technology and construction method - Defining work tasks - Definition - Precedence relationships among activities - Estimating activity durations - Estimating resource requirements for work activities - Coding systems.

UNIT III SCHEDULING PROCEDURES AND TECHNIQUES 9

Introduction - Project scheduling - Bar charts - CPM / PERT - Calculations for critical path scheduling - Activity float and schedules - Presenting project schedules - Use of advanced scheduling techniques - Project monitoring and control system - Resource levelling and allocation - Crashing of network.

UNIT IV LEAN CONCEPTS, TOOLS AND TECHNIQUES 9

Concepts in lean thinking - Principles of lean construction - Variability and its impact - Traditional construction and lean construction - Traditional project delivery - Lean construction and workflow reliability - Work structuring - Lean tools and techniques - Value stream mapping - Work sampling - Last planner system - Flow and pull based production - Last planner system - Look ahead schedule - Constraint analysis - Weekly planning meeting - Daily huddles - Root cause analysis - Continuous improvement - Just in time.

UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY 9

Lean construction implementation - Enabling lean through information technology - Lean in design - Design structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) - Sustainability through lean construction approach.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Perform formulations of projects
CO2 Develop project planning strategies
CO3 Prepare the activity schedule for the construction projects
CO4 Apply lean techniques to achieve sustainability in construction projects
CO5 Apply lean construction techniques in design and modeling

TEXTBOOKS:

1. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA, 2017.

REFERENCES:

1. Barcus S. W. and Wilkinson J. W., “Handbook of Management Consulting Services”, McGraw Hill, New York, 1986.
2. Joy P. K., “Total Project Management - The Indian Context”, New Delhi, Macmillan India Ltd., 1992.
3. Corfe C. and Clip B., “Implementing Lean in Construction: Lean and the Sustainability Agenda”, CIRIA, 2013.
4. Shang Gao and Sui Pheng Low, “Lean Construction Management: The Toyota Way”, Springer, 2014.

CO-PO & PSO MAPPING: CONSTRUCTION PROJECT MANAGEMENT THROUGH LEAN CONCEPTS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	1	3	2	3	2	3	3	3
2	3	2	3	2	2	2	2	1	3	1	3	2	3	3	3
3	3	3	2	3	3	2	2	1	2	1	3	2	3	3	3
4	3	2	3	2	2	2	2	1	3	2	3	2	3	3	3
5	3	2	2	2	3	2	2	1	3	2	3	2	3	3	3
Avg.	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23009 CONSTRUCTION QUALITY AND SAFETY L T P C
3 0 0 3

UNIT I CONSTRUCTION QUALITY MANAGEMENT 9

Importance of construction quality - Elements of quality - Quality characteristics - Quality by design - Quality conformance - Contractor quality control - Identification and traceability - Continuous chain management - Brief concept and application - Importance of specifications - Incentives and penalties in specifications - Workmanship as a mark of construction quality - Final inspection.

UNIT II CONSTRUCTION QUALITY ASSURANCE AND CONTROL 9

Construction quality assurance techniques - Inspection, testing, sampling - Documentation - Organization for quality control - Cost of quality - Introduction to TQM, Six Sigma concept in construction industry.

UNIT III CONSTRUCTION ACCIDENTS 9

Accidents and their causes - Human factors in construction safety - Costs of construction injuries - Occupational and safety hazard assessment - Problem areas in construction safety.

UNIT IV SAFETY DURING CONSTRUCTION 9

Basic terminology in safety - Types of injuries - Safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation and accident indices - Violation, penalty.

UNIT V SAFE OPERATING PROCEDURES 9

Safety during alteration, demolition works - Earthwork, steel construction, temporary structures, masonry and concrete construction, cutting and welding - Construction equipment, materials handling disposal and hand tools - Other hazards - Fire, confined spaces, electrical safety.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Apply the quality standards for preparing quality system documents
CO2 Select the techniques and tools for quality assurance and control in construction
CO3 Develop the knowledge on accidents and their causes
CO4 Develop the knowledge about safety programmes and job-site safety assessment
CO5 Apply knowledge while designing for safety and safety procedures

TEXTBOOKS:

1. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, McGraw Hill, 2001.

REFERENCES:

1. K. B. Rajoria, Deepak Naryan and Deepak Gupta, “Practices in Construction”, CBS Publishers & Distributors Pvt. Ltd., ISBN:978-93-90709-33-5, 2021.
2. Bhattacharjee S. K., “Safety Management in Construction (Principles and Practice)”, Khanna Publishers, New Delhi, 2011.
3. Albert Lester, “Project Management, Planning and Control”, 7th Edition, Butterworth- Heinemann, USA, 2017.
4. Patrick X. W. Zou, Riza Yosia Sunindijo, “Strategic Safety Management in Construction and Engineering”, John Wiley & Sons Ltd., 2015.

CO-PO & PSO MAPPING: CONSTRUCTION QUALITY AND SAFETY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	2	2	2	1	2	2	2	2	3	3	3
2	3	3	2	2	2	2	2	1	2	1	2	2	3	3	3
3	3	2	3	2	2	2	2	1	2	1	2	2	3	3	3
4	3	3	2	2	2	2	2	1	2	2	2	2	3	3	3
5	3	3	3	2	2	2	2	1	2	2	2	2	3	3	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23010 ADVANCED CONSTRUCTION TECHNIQUES L T P C
3 0 0 3

UNIT I 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 - Well points - Dewatering for underground open excavation.

UNIT II 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.

UNIT III 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 - Erection of articulated structures and space decks.

UNIT IV 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 techniques - Sub grade water proofing - Soil stabilization techniques.

UNIT V 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

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the modern construction techniques used in the sub structure construction
CO2 Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
CO3 Understand the concepts used in the construction of special structures
CO4 Knowledge on various strengthening and repair methods for different cases
CO5 Identify the suitable demolition technique for demolishing a building

TEXTBOOKS:

1. Sarkar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.

REFERENCES:

1. Jerry Irvine, “Advanced Construction Techniques”, CA Rocket, 1984.
2. Patrick Powers J., “Construction Dewatering: New Methods and Applications”, John Wiley & Sons, 1992.
3. Peter H. Emmons, “Concrete Repair and Maintenance Illustrated”, Galgotia Publications Pvt. Ltd., 2008.
4. Robertwade Brown, “Practical Foundation Engineering Handbook”, McGraw Hill Publications, 1995.

CO-PO & PSO MAPPING: ADVANCED CONSTRUCTION TECHNIQUES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	3	3	2	2	-	1	1	2	1	3	2	3
2	1	-	-	2	2	2	3	-	1	1	2	1	2	3	2
3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
Avg.	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

ME23C07 **ENERGY EFFICIENT BUILDINGS** **L T P C**
3 0 0 3

UNIT I INTRODUCTION **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 II 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 - Air filtration and odor removal.

UNIT III 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 - 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 IV HEAT CONTROL AND VENTILATION **9**

Hourly solar radiation - Heat insulation - Terminology - Requirements - Heat transmission through building sections - Thermal performance of building sections - Orientation of buildings - Building characteristics for various climates - Thermal design of buildings - Influence of design parameters - Ventilation - Requirements - Ventilation design - Energy conservation in ventilating systems - Design for natural ventilation - Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency - An overview of design concepts and architectural interventions - Embodied energy - Low embodied energy materials - Passive downdraft evaporative cooling - Design of energy efficient buildings for various zones - Various climatic conditions - Case studies of residences, office buildings and other buildings in each zones - Commonly used software packages in energy efficient building analysis and design - Energy audit - Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain environmental energy supplies on buildings
CO2 Explain the passive solar heating, cooling system
CO3 Discuss the various aspects of day-lighting and electrical lighting in abuilding
CO4 Predict and design building ventilation and heat control for indoor comfort
CO5 Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

TEXTBOOKS:

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John nd Sons Inc,3rd Edition, 2014.

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.
3. “Residential Energy: Cost Savings and Comfort for Existing Buildings”, John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
4. Majumdar M. (Ed.), “Energy - Efficient Buildings in India”, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

CO-PO & PSO MAPPING: ENERGY EFFICIENT BUILDINGS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	2	-	-	3	3	2	1	-	-	3	3	2	1
2	3	-	2	-	-	3	3	-	-	-	-	-	3	2	1
3	3	-	2	-	-	3	3	-	-	-	-	-	3	2	2
4	3	3	3	-	-	3	3	-	-	1	-	-	3	3	3
5	3	3	3	1	2	3	3	2	-	1	-	-	2	3	3
Avg.	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**1**	**-**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23011 **DIGITALIZED CONSTRUCTION LAB** **L T P C**
0 0 6 3

LIST OF EXPERIMENTS (theory components to be completed prior to practical):
To implement the digital knowledge in construction (use relevant softwares)

1. Introduction and understanding of Primavera project planner for construction
2. Using Primavera project planner, update the schedule of the project of a construction project
3. Introduction and understanding of MS Project for a construction project
4. Using MS project, schedule the construction project planning
5. Introduction to BIM in construction projects
   Development of BIM for small construction project
6. Progress the work flows in construction project using BIM
7. Development of bid management for a small firm construction industry using software.

TOTAL: 90 PERIODS

COURSE OUTCOMES:
On completion of this course, the student is expected to be able to:
CO1 Understand the importance of latest softwares in a construction industry
CO2 Plan a construction project using Primarvera
CO3 Plan a construction project using MS project
CO4 Develop a BIM information model
CO5 Analyze the bid management and its effectiveness using bid management software

REFERENCES:

1. Kenneth C Laudon and Jane Price Laudon, Management Information Systems Organization and Technology, Prentice Hall, 1996.
2. Kathy Schwalbe, information Technology Project management, CENGAGE Learning Custom Publishing, 6th Revised Edn, 2010.
3. Vinayagam P, Vimala A, Planning and Managing Projects with Primavera (P6) Project Planner, I K International Publishing House, Pvt. Ltd, 2017.
4. Paul E, Harris, Planning and Control using Microsoft Project 2013, 2016 & 2019, Eastwood Harris Pvt Ltd, 2019.

CO-PO & PSO MAPPING: DIGITALIZED CONSTRUCTION LAB

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	3	3	2	2	3	2	2	2	3	2	3
2	3	3	2	2	3	2	2	2	2	2	3	3	2	2	3
3	2	3	2	2	3	3	2	2	3	2	2	2	2	3	2
4	2	2	3	3	3	3	3	2	3	2	3	3	3	2	3
5	3	2	3	2	3	2	3	3	3	2	3	3	2	2	3
Avg.	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**3**

• 1' = Low; '2' = Medium; '3' = High

VERTICAL III: GEOTECHNICAL

CE23012 GEO-ENVIRONMENTAL ENGINEERING L T P C
3 0 0 3

UNIT I GENERATION OF WASTES AND CONSQUENCES OF SOIL POLLUTION 8

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

UNIT II SITE SELECTION AND SAFE DISPOSAL OF WASTE 10

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

UNIT III TRANSPORT OF CONTAMINANTS 8

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

UNIT IV WASTE STABILIZATION 10

Stabilization - Solidification of wastes - Micro and macro encapsulation - Absorption, Adsorption, Precipitation - Detoxification - Mechanism of stabilization - Organic and inorganic stabilization - Utilization of solid waste for soil improvement.

UNIT V REMEDIATION OF CONTAMINATED SOILS 9

Exsitu and insitu remediation-Solidification, bio-remediation, incineration, soil washing, electro kinetics, soil heating, vetrification, bio-venting.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 understand basic knowledge of concepts and principles of Geo-environmental Engineering
CO2 Select site for safe disposal of waste
CO3 Be aware of soil stabilization by utilizing solid waste
CO4 Assess the contamination in the soil and to select suitable remediation methods based on contamination
CO5 Prepare the suitable disposal system for particular waste

TEXTBOOKS:

1. Manoj Datta, “Waste Disposal in Engineered landfills”, Narosa Publishing House, 1997.
2. Manoj Datta, B.P. Parida, B.K. Guha, “Industrial Solid Waste Management and Landfilling Practice”, Narosa Publishing House, 1999.

REFERENCES:

1. Hari D. Sharma and Krishna R. Reddy, “Geo-Environmental Engineering” -John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., “Geotechnical Practice for waste disposal”, Chapman & Hall, London 1993.
3. Westlake, K, “Landfill Waste pollution and Control”, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., “Hazardous Waste Management”, McGraw Hill, Singapore, 1989.

CO-PO & PSO MAPPING: GEO-ENVIRONMENTAL ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	3	3	3	3	3	2	2	2	3	2	3	3
2	3	2	3	3	3	2	3	2	2	2	2	3	2	2	3
3	3	2	2	3	2	3	2	3	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	3	2	2	2	3	2	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23013 GROUND IMPROVEMENT TECHNIQUES L T P C
3 0 0 3

UNIT I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES 8

Geotechnical problems in alluvial, lateritic and black cotton soils - Role of ground improvement in foundation engineering - Methods of ground improvement - Selection of suitable ground improvement techniques based on soil conditions.

UNIT II DEWATERING 10

Dewatering Techniques - Well points - Vacuum and electroosmotic methods - Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits - Design for simple cases.

UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 10

Insitu densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques - Simple design - Relative merits of above methods and their limitations.

UNIT IV EARTH REINFORCEMENT 9

Concept of reinforcement - Types of reinforcement material - Reinforced earth wall - Mechanism - Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

UNIT V GROUTING TECHNIQUES AND SOIL STABILIZATION 8

Types of grouts - Grouting equipment and machinery - Injection methods - Grout monitoring - Stabilization with cement, lime, chemicals and industrial wastes - Stabilization of expansive soil.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify various problems associated with soil deposits and selection of ground improvement methods

CO2 Understand dewatering techniques and design for simple cases as per needs and specifications.

CO3 Understand the concept involved for in-situ treatment of cohesive and cohesionless soils and design for simple cases

CO4 Appreciate the concept of earth reinforcement and its applications and design for simple cases in various engineering structure.

CO5 Understand the soil grouting and stabilization techniques

TEXTBOOKS:

1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media, 2005.
2. Bikash Chandra chattopadhyay and Joyanta Maity, “ Ground Improvement Techniques”, PHI Learning Pvt. Ltd., 2017.

REFERENCES:

1. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, 1994.
2. Moseley, M.P., “Ground Improvement”, Blockie Academic and Professional, Chapman and Hall, Glasgow, 2004.
3. Winterkorn, H.F. and Fang, H.Y. “Foundation Engineering Hand Book”. Van Nostrand Reinhold, 1994.
4. Koerner, R.M., “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, Jersey, 2012.

CO-PO & PSO MAPPING: GROUND IMPROVEMENT TECHNIQUES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	3	3	3	3	2	2	2	3	2	3	2
2	3	3	2	3	3	2	2	2	2	2	2	3	2	2	2
3	3	2	2	3	3	3	2	2	2	2	2	3	2	2	2
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

- 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23014 SOIL DYNAMICS AND MACHINE FOUNDATIONS L T P C
3 0 0 3

UNIT I THEORY OF VIBRATION 9

Nature dynamic loads - Vibrations of single degree freedom system - Free vibrations of spring - mass systems - Forced vibrations - Viscous damping - Transmissibility - Principles of vibration measuring instruments - Effect of Transient and Pulsating loads

UNIT II WAVE PROPAGATION 9

Elastic waves in rods of infinite length - Longitudinal and Torsional - Effect of end conditions - Longitudinal and torsional vibrations of rods of finite length - Wave Propagation in infinite, homogeneous isotropic and elastic medium - Wave propagation in elastic half space - Typical values of compression wave and shear wave velocity - Wave propagation due to Machine foundation - Surface wave - Typical values - Particle movements and velocity.

UNIT III DYNAMIC PROPERTIES OF SOILS 9

Dynamic stress - Strain characteristics - Principles of measuring dynamic properties - Laboratory Techniques - Field tests - Factors affecting dynamic properties - Typical values - Dynamic bearing capacity - Dynamic earth pressure.

UNIT IV FOUNDATION FOR DIFFERENT TYPES OF MACHINES 9

Types of machines and foundation - General requirements - Modes of vibration of a rigid foundation - Method of analysis - Linear elastic weightless spring method - Elastic half space method - Analog Method - Design of block foundation - Special consideration for rotary, Impact type of machines - Codal Provisions.

UNIT V INFLUENCE OF VIBRATION AND REMEDIATION 9

Mechanism of Liquefaction - Influencing factors - Evaluation of Liquefaction potential based on SPT- Force Isolation - Motion Isolation - Use of spring and damping materials - Vibration control of existing machine foundation - Screening of vibration - Open trenches - Pile Barriers - Salient construction aspects of machine Foundations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to be able to:

CO1 understand the basic knowledge about the theory of vibration.
CO2 understand the different types of waves and its behaviour.
CO3 acquire knowledge about various laboratory and field tests to determine the dynamic soil properties and its interpretation.
CO4 Understand the types of machines and foundation and simple design of machine foundation
CO5 assess the influence of vibrations and selection of remediation methods based on the nature of vibration, properties and behaviour of soil.

TEXT BOOKS:

1. Swamisaran, “Soil Dynamics and Machine Foundations”, Galgotia Publications Pvt.Ltd. (Second Edition) 2006, (Reprint 2010), New Delhi-110002
2. Srinivasulu. P, and Vaidyanathan. C. V, “Handbook of Machine Foundations”, Tata McGraw-Hill, 2007

REFERENCES:

1. Kamaswara Rao., “Vibration Analysis and Foundation Dynamics”, Wheeler Publishing, New Delhi, 1998.

2. Kameswara Rao., “Dynamics Soil Tests and Applications”, Wheeler Publishing, New Delhi, 2003.
3. Moore, P.J., “Analysis and Design of Foundation for Vibration”, Oxford and IBH, 2005
4. Steven L. Kramer, “Geotechnical Earthquake Engineering”, Prentice Hall, 2014.

CO-PO & PSO MAPPING: SOIL DYNAMICS AND MACHINE FOUNDATIONS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	3	3	3	3	2	2	2	3	2	3	2
2	3	3	3	3	2	2	3	2	2	2	2	3	2	2	3
3	3	2	3	3	2	3	2	2	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23015 **ROCK MECHANICS** **LT P C**
3 0 0 3

UNIT I CLASSIFICATION AND INDEX PROPERTIES OF ROCKS 6

Geological classification - Index properties of rock systems - Classification of rock masses for engineering purpose - Rock Mass Rating and Q System.

UNIT II ROCK STRENGTH AND FAILURE CRITERIA 12

Modes of rock failure - Strength of rock - Laboratory measurement of shear, tensile and compressive strength. Stress - strain behaviour of rock under compression - Mohr -Coulomb failure criteria and empirical criteria.

UNIT III INITIAL STRESSES AND THEIR MEASUREMENTS 10

Estimation of initial stresses in rocks - influence of joints and their orientation in distribution of stresses - measurements of in-situ stresses - Hydraulic fracturing - Flat jack method - Over coring method.

UNIT IV APPLICATION OF ROCK MECHANICS IN ENGINEERING 10

Simple engineering application - Underground openings - Rock slopes - Foundations and mining subsidence.

UNIT V ROCK STABILISATION *7*

Introduction - Rock support and Rock reinforcement - Principles - Support reaction curves - Shotcreting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the characterization and rating the rock mass.
CO2 Arrive at the behaviour of rock for the given project.
CO3 Calculate the insitu stresses of rock.
CO4 Design underground excavation, open excavation and sub-structures.
CO5 Design suitable support system under unstable condition.

TEXTBOOKS:

1. Goodman, P.E. “Introduction to Rock Mechanics”, John Wiley and Sons, 1999.
2. Ramamurthy. T., “Engineering in Rocks for Slopes, Foundation and Tunnels”, Third Edition, PHI Learning Private Limited, New Delhi, 2014.

REFERENCES:

1. Brown, E.T. “Rock Characterization Testing and Monitoring”. Pergaman Press 1991.
2. Arogyaswamy, R.N.P., “Geotechnical Application in Civil Engineering”, Oxford and IBH, 1991.
3. Hook E. and Bray J., “Rock slope Engineering, Institute of Mining and Metallurgy”, U.K. 2004.
4. Brady, B.H.G. and Brown, E.T., “Rock mechanics for underground mining”, Third Edition, Kluwer Academic Publishers, Dordrecht, 2006.

CO-PO & PSO MAPPING: ROCK MECHANICS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	3	3	3	3	2	2	2	3	2	3	2
2	3	3	3	3	2	2	3	2	2	2	2	3	2	2	3
3	3	2	3	3	2	3	2	2	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

- 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23016 EARTH AND EARTH RETAINING STRUCTURES L T P C
3 0 0 3

UNIT I EARTH PRESSURE THEORIES 9

State of stress in retained soil mass - Earth pressure theories - Classical and graphical techniques (Culmann's method) - Active and passive cases - Earth pressure due to external loads.

UNIT II STABILITY OF RETAINING STRUCTURES 9

Retaining structure - Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence.

UNIT III SHEET PILE WALLS 9

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls - free earth support method - fixed earth support method.

UNIT IV SUPPORTED EXCAVATIONS 9

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Soil anchors and Soil pinning -Basic design concepts - Slurry Supported Trenches-Diaphragm walls - Basic principles and construction techniques.

UNIT V STABILITY OF SLOPES 9

Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method. Role of geosynthetics in stabilization of slopes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Analyse the earth pressure acting on retaining structures by applying classical theories and graphical techniques

CO2 Apply the knowledge of engineering to analyse earth pressure and design rigid retaining structures considering effect of compaction, wall flexibility, pore water pressure

CO3 Analyse and design flexible earth retaining walls using free and fixed earth support

CO4 Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations and slurry supported excavations

CO5 Analyse the stability of infinite and finite slopes through total stress and effective stress analysis by considering the actual shape of failure surface expected in the field

TEXTBOOKS:

1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, ThirdEdition, CRC Press Taylor & Francis Group, 2013.
2. Das, B.M., Principles of Geotechnical Engineering, Eighth Edition, Cengage Learning, 2014.
3. Militisky, J. and Woods, R., Earth and Earth retaining structures, Third Edition, CRC Press Taylor & Francis Group, 2013.

REFERENCES:

1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Book- source, 2010.
2. Day, R.W., Geotechnical and Foundation Engineering: Design and Construction, McGraw Hill, 1999.
3. Mandal, J.N., Reinforced Soil and Geotextiles, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.
4. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Seventh Edition, Prentice Hall, 2006.
5. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley - Interscience Publication, 1984.

6. Petros P. Xanthakos., Slurry walls as structural systems, McGraw-Hill, Inc., New York, 2016.
7. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow, 1986.
8. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.

CO-PO & PSO MAPPING: EARTH AND EARTH RETAINING STRUCTURES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	b	3	2	2	3	3	2	3	2	2	2	3	2	3	2
2	3	3	3	2	2	2	2	2	2	2	2	3	2	2	3
3	3	3	3	2	2	3	2	2	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	2	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23017 **PILE FOUNDATIONS** **L T P C**
3 0 0 3

UNIT I PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE 10

Necessity of pile foundation - classification of piles - Factors governing choice of type of pile - Load transfer mechanism - effect of pile installation on soil condition - criteria for pile socketing - responsibility of engineer and contractor

UNIT II AXIAL LOAD CAPACITY OF PILES AND PILE GROUP 10

Allowable load capacity of piles and pile groups - Static and dynamic methods - for cohesive and cohesionless soil - negative skin friction - group efficiency -Settlement of piles and pile group -IS codal provisions and IRC guide lines.

UNIT III LATERAL AND UPLIFT LOAD CAPACITIES OF PILES 9

Piles under Lateral loads - Broms method, elastic, p-y curve analyses - Batter piles - response to moment - piles under uplift loads - under reamed piles -IS codal provision - IRC guide lines.

UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUP 9

Structural design of pile - structural capacity - pile and pile cap connection - pile cap design - shape, depth, assessment, and amount of steel - truss and bending theory- Reinforcement details of pile and pile caps- IS codal provision - IRC guide line.

UNIT V CONSTRUCTION ASPECTS AND QUALITY CONTROL 7

Piling equipment and construction methods - Evaluation of axial load capacity from field test results - Pile load test - Pile integrity test -IS codal provision.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Classify the pile foundation along with the load transfer mechanism and piling equipment
CO2 Determine the vertical load carrying capacity and the settlement of pile and pile group
CO3 Analyse the pile subjected to lateral and uplift load with reference to codal provision
CO4 Design the pile and pile caps and provide the reinforcement details according to codal provisions
CO5 Understand the piling equipment and construction methods and evaluate the axial load capacity from field test results

TEXTBOOKS:

1. Das, B.M., Principles of Foundation Engineering, Cengage Learning India Pvt. Ltd. 2016.
2. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
3. Tomlinson, M.J. Pile Design and Construction Practice, 4th Edition, Spon Press, New York, 2004.

REFERENCES:

1. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
2. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 2001.
3. Donald, P., Coduto, Foundation Design Principles and Practices, Pearson India Education Services Pvt. Ltd., 2014.
4. Varghese P.C.," Foundation Engineering", PHI Learning Private Limited, New Delhi, 2012.
5. Reese,L.C., Isenhower,W.M. and Wang,S.T. Analysis and Design of Shallow and Deep Foundations, John Wiley and Sons, New York, 2005.
6. Varghese P.C.," Limit State Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi, 2011.
7. Reese, L. C. and Van Impe, W. F., Single Piles and Pile Groups Under Lateral Loading, Taylor and Francis, London, 2011.
8. Satyendra Mittal, Pile Foundation - Design and Construction including Well Foundation, CBS Publishers and Distributers Pvt. Ltd., 2019.

CO-PO & PSO MAPPING: PILE FOUNDATIONS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	3	3	2	3	2	2	2	3	2	3	2
2	3	3	3	2	2	2	2	2	2	2	2	3	2	2	3
3	3	3	3	2	2	3	2	2	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	2	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL IV: GEO-INFORMATICS

GI23C02 ENVIRONMENTAL GEOINFORMATICS L T P C
3 0 0 3

UNIT I WATER AND THE ENVIRONMENT 9

Sources and demands of water - Characteristics of water - Point and non-point sources of water pollution - Spectral responses of clear and contaminated water - Chlorophyll - Remote Sensing of Water quality assessment - Classification of water quality for various purposes, Sampling procedure, quality analysis, Database creation and quality modeling using GIS. Database Creation and designing water supply network, sewerage network using GIS. Runoff estimation - Flood prediction modeling - Aquifer vulnerability modeling.

UNIT II SOIL CONSERVATION AND MANAGEMENT 9

Formation of Soils - Classification - Landforms - Soil erosion - Factors influencing soil erosion, soil contamination - Distribution and accumulation of contaminants such as toxic metals, synthetic chemicals in soil - Mining pollution - Methods of conservation - Afforestation - EMR responses with contaminated soil - Modeling soil characteristics using satellite data - Soil degradation assessment using Remote Sensing and GIS - Land reclamation.

UNIT III SOLID WASTE MANAGEMENT 9

Definition - Sources - elements of integrated waste management and roles of stakeholders - Seven elements and seven step approach to integrated solid waste management planning, identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site - Waste allocation - leachate model - Case studies.

UNIT IV AIR POLLUTION 9

Structure and composition of atmosphere - Sources and classification of air pollutants, Air Quality Standards - Chemical and Physical Components - Sampling - Mapping of atmospheric pollution - Air pollution due to industrial activity - Plume behaviors - Dispersion model: Gaussian Plume model - Introduction to commonly used software-based models such as ADMS, AERMOD, CALINE, CALPUFF, DEGADIS, HYROAD, INDUSTRIAL SOURCE COMPLEX, SCREEN, HYSPLIT, INDEX etc. - Remote Sensing to monitor atmosphere constituents - Case Studies.

UNIT V SENSORS AND DATA FOR ENVIRONMENTAL MONITORING 9

Sensors for environmental monitoring - sensors - LIDAR- LASER Remote Sensing - EMR - absorption spectrometers - Selection of ground truth sites-sea truth observation - Radar techniques for sensing ocean surface - Thermal measurements - Application of remote sensing for oil slicks mapping - Chlorophyll detection - Fisheries resources - Coastal marine studies - Determination of temperature and sea state.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the possible applications of remote sensing and GIS in water quality analysis and network design
CO2 Understand the possible applications of remote sensing and for soil conservation
CO3 Understand the possible applications of remote sensing and for solid waste management
CO4 Understand the possible applications of remote sensing and for air pollution mapping and modeling
CO5 Understand the possible applications of remote sensing and for climate change perspectives

TEXT BOOKS:

1. Susan L. Ustin., “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley& Sons Inc, 2004.
2. Eric Charles Barrett., Leonard Frank Curtis, “Introduction to Environmental Remote Sensing, Chapman and Hall”, 2nd edition, 1982.
3. Andrew N. Rencz., “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley & Sons Inc, 3rd Edition, 2004.
4. Baretl, E.C. and Culis I.F., “Introduction to Environmental Remote Sensing”, 2nd edition, Chapman and Hall, New York, 2013.

REFERENCES:

1. Jr. Lintz, Joseph, David S. Simonett., “ Remote sensing of environment Addision Wesley”, 1976.
2. Martin Paegelow and María Teresa Camacho Olmedo., “Modelling Environmental Dynamics: Advances in Geomatic Solutions”, Springer, 2008.
3. Jonathan Li and Xiaojun Yang., “Monitoring and Modeling of Global Changes: A Geomatics Perspective”, Springer Remote Sensing/Photogrammetry, 2015.
4. Robert Scally., “GIS for Environmental Management”, ESRI Press, 2006.
5. Andrew Skidmore., “Environmental Modelling with GIS and Remote Sensing”, CRC Press, 2017.

CO-PO & PSO MAPPING: ENVIRONMENTAL GEOINFORMATICS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
2	3	3	2	3	3	3	3	1	2	2	2	3	3	3	2
3	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
4	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
5	3	2	2	3	3	3	3	1	2	2	2	3	3	3	2
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23018 **TRANSPORTATION GEOMATICS** **L T P C**
3 0 0 3

UNIT I ENGINEERING SURVEYS AND GEOMETRIC DESIGN 9

Classification of roads and railways - Alignment surveys and investigations using conventional and remote sensing techniques (preliminary, reconnaissance and final location surveys) - Types of Highway pavements - Design principles of highway geometric elements.

UNIT II URBAN TRANSPORTATION SYSTEMS AND PLANNING 9

Urban transportation: policy alternatives - Transportation and the environment - Urban transport planning processes - Socio-demographic data and travel surveys - Transportation modelling - Traffic congestion - Plan evaluation and implementation - Planning and financing - Critiques of transportation modelling and forecasting.

UNIT III REMOTE SENSING APPLICATIONS IN TRANSPORTATION 9

Traffic analysis - Accident analysis - Site suitability analysis for transport infrastructure - Population distribution studies- Improving rural road network - Regional road network connectivity - Vehicle tracking - Incident identification and management.

UNIT IV GIS IN TRANSPORTATION ANALYSIS 9

Transportation analysis in GIS: Network flows - Shortest path algorithms: Distance and Cost-based - Transportation databases: creation and maintenance - Facility location: Catchment area analysis - Vehicle routing - Route alignment studies: Raster analysis - Highway maintenance - Case studies.

UNIT V INTEGRATED TRANSPORT MODELS 9

Land use transport interaction models - Transport environment interaction models - Intelligent Transportation Systems (ITS) - Development - Architecture - Integration with GIS, GPS, IOT - Traffic volume estimation and monitoring - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand various highway geometric elements and surveys carried out for highway alignment
CO2 Understand the factors involved in urban transportation planning
CO3 Apply remote sensing techniques for transportation problems
CO4 Apply GIS for transportation analysis
CO5 Gain knowledge on latest developments in transportation planning

TEXT BOOKS:

1. Harvey J. Miller., Shih-Lung Shah, “Geographic Information Systems for Transportation -Principles and Applications”, Oxford University Press, 2001.
2. John Stillwell, Graham Clarke., “Applied GIS and Spatial Analysis”, John Wiley & Sons Ltd, 2004.

REFERENCES:

1. Papacostas, C.S, Prevedouros, P.D., “Transportation Engineering and Planning, Prentice- Hall India”, 2015.
2. L.R.Kadiyali., “Transportation Engineering”, Khanna Book publishing Co (P) Ltd, 2021.
3. Jotin Khisty C and B.Kent Lall, “Transportation Engineering-An Introduction”, Prentice Hall of India Private Limited, 2009.
4. Igor Ivan, Itzhak Benenson, Bin Jiang, Jiri Horak and James Haworth., “Geoinformatics for Intelligent Transportation System”, Springer International Publishing AG, 2015.

5. Barry Boots, Atsuyuki Okabe and Richard Thomas., “Modelling Geographical Systems - Statistical and computational applications”, Kluwer Academic Publishers, 2014.

CO-PO & PSO MAPPING: TRANSPORTATION GEOMATICS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	3	3	3	3	3	2		3	2	2	2
2	3	3	3	3	3	3	3	3	3	2	3	3	2	2	2
3	3	3		3	3	3	3	3	3	-	-	-	3	3	3
4	3	3	3	-	2		3	-	-	3	3	3	3	3	3
5	3	3	3	-	3	3	3	-	-	3	3	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

GI23C03 GEOMATICS FOR HYDROLOGY AND WATER RESOURCES L T P C
3 0 0 3

UNIT I HYDROLOGIC COMPONENTS 9

Hydrologic cycle - Estimation of various components - Clouds: Types of Clouds - rainfall: Types of Rainfall - runoff - evaporation - transpiration - Evapo-transpiration -Interception - Depression storage - Spectral properties of water.

UNIT II SURFACE WATER MODELLING 9

Drainage basin - Delineation and codification of watershed - Morphometric analysis - Hydrological Modelling - Rainfall - runoff modelling - USDA-SCS-CN Method - Urban Hydrology - LiDAR Mapping for Urban area - Impact of Climate change on Hydrological modeling - Water quality mapping and monitoring - Correlation model for pollution detection.

UNIT III RISK AND DAMAGE ASSESSMENT 9

Mapping of snow-covered area - Snow melt runoff - Glacier runoff modelling - Flood forecasting - Flood Risk Zoning - Flood damage assessment - Flood Modelling - Early warning system for Flood mitigation - drought- Types - Assessment of droughts and mitigation - Desertification - Water harvesting methods, Assessments of intervention measures.

UNIT IV GROUNDWATER MODELLING 9

Origin - Classification and properties of aquifer - Ground water potential identification - Surface indicators - Aquifer parameters - Hydrologic budgeting - Different types of Ground water models - Mathematical modelling of groundwater system - Sea water intrusion - Interfacing GIS with groundwater model - Artificial recharge.

UNIT V IRRIGATION AND WATERSHED MANAGEMENT 9

Crop water requirements - Crop Stress: Biophysical Indicators - Irrigation performance assessment - Reservoir Sedimentation Studies - Capacity curve generation - modelling of reservoir siltation - Impact of climate and land use change on drainage basin - Erosion Estimation using Remote sensing - Prioritization of watersheds - watershed modelling for sustainable development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the challenges faced by the scientific community in the management of water in the past as well as present situations in the face of ever-changing climate and socioeconomic conditions

CO2 Develop knowledge on the previously used scientific methods and environment development with particular reference to the environment status and scope of geospatial technology to address the WRM issues

CO3 Comprehend the current research trends and the remote sensing data sources, products and tools that are of value along with their limitations so as to find solutions to the issue of various phenomena and domain of WRM

CO4 Analyze the complicated and multi-source and layered problems of water resources management with state of the art, tools and techniques for sustained livelihood

CO5 Apply the knowledge in the conceptualization of extraction and implementation of the Geospatial based solutions sets and to interpret them with tools from ancillary sources for dependable policy making

TEXT BOOKS:

1. Gert A. Schultz, Edwin T. Engman, "Remote Sensing in Hydrology and Water Management", Springer, 2011.
2. S. K. Gupta, "Modern Hydrology and Sustainable Water Development", John Wiley & Sons, 2010.
3. K. Ramamohan Reddy, B. Venkateswara Rao, C. Sarala, "Hydrology and Watershed Management with a Focal Theme on Ecosystem Resilience - Rural and Urban Water Requirements", 2014.

REFERENCES:

1. Schultz, G. A. and Engman, E. T., "Remote Sensing in Hydrology and Water Management", Springer, 2000.
2. David Keith Todd , "Groundwater Hydrology", John Wiley & Sons, New York, 2nd Edition, 2005.
3. H. M. Raghunath , "Hydrology- principles, Analysis, Design", New Age International, 2000.
4. L. Asawa, "Irrigation and Water Resources Engineering", New Age International, 2008.
5. Andrew Skidmore, "Environmental Modelling with GIS and Remote Sensing", 2017.
6. Dorota Swiatek, Stefan Ignar, "Modelling of Hydrological Processes in the Narew Catchment", Springer Science & Business Media, 2011.
7. Tim Davie, "Fundamentals Of Hydrology", 3rd edition, 2019.

CO-PO & PSO MAPPING: GEOMATICS FOR HYDROLOGY AND WATER RESOURCES

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	3	-	-	-	-	-	-	-	3		
2	3	3	3	-	3	-	-	-	-	-	-	-	3	3	
3	3	3	-	3	3	-	-	-	-	-	-	-	3	3	
4	3	3	3		2	-	-	-	-	-	-	-	3	2	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

GI23C04 GEOMATICS FOR DISASTER AND RISK MITIGATION L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Disaster: Definition and Classification - Hydrological and geological disasters, characteristics crisis and consequences-Role of Government administration, University research organization and NGO's-International disaster assistance-Sharing technology and technical expertise.

UNIT II LONG TERM MITIGATION MEASURES 9

Needs and approach towards prevention-Principles and components of mitigation Disaster legislation and policy - Insurance - Cost effective analysis - Utilization of resources -Training - Education-Public awareness-Roles of media

UNIT III SAFETY RATING OF STRUCTURES 9

Slope stability of Ghat roads -Structural safety of Dams, Bridges, Hospitals, Industrial structures, - Disaster resistant structures-Low cost housing for disaster prone areas-Cyclones helter projects and their implications-Reconstruction after disasters: Issues of practices.

UNIT IV SPACE SCIENCE INPUT IN DISASTER MANAGEMENT 9

Remote sensing in Hazard evaluation- zonation - Risk assessment - Damage assessment- Land use planning and regulation for sustainable development-Communication satellite application- Network-Use of Internet - Warning System-Post disaster review-Case studies.

UNIT V EMERGENCY PLANNING USING SPATIAL AND NON-SPATIAL DATA 9

Information systems management-Spatial and non-spatial data bank creation- Operational emergency management - Vulnerability analysis of infrastructure and settlements - Pre disaster and post disaster planning for relief operations - Potential of GIS application in development planning - Disaster management plan-Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Gain knowledge on various types of disasters and infrastructural facilities available for managing disasters
CO2 Plan long term disaster mitigation measures
CO3 Evaluate the safety of the various social structures
CO4 Use remote sensing data products for disaster management
CO5 Apply GIS concepts in disaster management

TEXT BOOKS:

1. J. P. Singhal., "Disaster Management", Laxmi Publications, 2019 ISBN-10:9380386427, ISBN-13:978-9380386423.
2. Tushar Bhattacharya., "Disaster Science and Management", McGraw Hill India EducationPvtLtd., 2017, ISBN-10:1259007367, ISBN-13:978-1259007361.

REFERENCES:

1. F.G.Bell., "Geological Hazards: Their assessment, avoidance and mitigation", SPON, 2007.
2. George G.Penelis and Andreas J.Kappos., "Earthquake Resistant Concrete Structures ", CRC Press; 1st edition, 1996.
3. "Mitigating Natural Disasters, Phenomena, Effects and Options, A Manual for policy makers and planners", United Nations, 1991.

4. Gupta, Anil.K, Sreeja S, Nair, Bemmerlein-Lux, Florian, Chatterji, Sandhya., “Disaster Management and Risk reduction: Role of Environmental Knowledge", Narosa Publishing House, 2013.
5. Kapur Anu, “Vulnerable India: A Geographical study of Disasters”, IIAS and sage Publishers, 2010.

CO-PO & PSO MAPPING: GEOMATICS FOR DISASTER AND RISK MITIGATION

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	-	-	-	3	3	3	3	2	-	3	-	2	2
2	-	3	-	-	-	3	3	3	3	2	3	3	-	2	2
3	3	3	-	3	-	3	3	3	3	-	-	-	-	3	3
4	3	3	3	3	3	-	3	-	-	3	3	3	3	3	3
5	3	3	3	-	3	3	3	-	-	3	3	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23019 GEOMATICS FOR AGRICULTURE AND FORESTRY L T P C
3 0 0 3

UNIT I CROP INVENTORY AND REMOTE SENSING 9

Introduction - Leaf optical properties - Identification of crops and crop inventorying - crop acreage estimation - Vegetation indices - Yield estimation - Crop production forecasting through digital analysis - Microwave and hyper spectral sensing for crop inventory - Crop monitoring and condition assessment- Case studies.

UNIT II REMOTE SENSING FOR SOIL 9

Introduction - Soil survey, types of soil surveys - Soil genesis and soil classification - Soil taxonomy - Soil reflectance properties - Soil mapping using remote sensing - Problem soils - Saline, alkali soil characteristics - Mapping of saline alkaline soils-soil erosion and sedimentation - Assessment of soil erosion - Estimation of reservoir capacity.

UNIT III LAND EVALUATION AND MANAGEMENT 9

Introduction - Land use/Land cover definition - Land use/ Land cover classification - Concepts and approaches of land evaluation - Change dynamics - Land capability assessments - Decision support system for land use planning - Optimum land use planning for sustainable agriculture.

UNIT IV DAMAGE ASSESSMENT 9

Introduction - Damage by pests and diseases - Crop loss assessment by floods - Flood hazard zone mapping- Remote sensing capabilities and contributions for drought management - Land degradation due to waterlogging and salinity - Crop stress - Reflectance properties of stressed crops - Identification of crop stress - Agricultural insurance in India - CCIS, ECIS, FIIS and NAIS.

UNIT V FOREST MANAGEMENT 9

Introduction - forest taxonomy - Inventory of forests-forest type and density mapping - Biomass assessment - Timber volume estimation - Factors for forest degradation - Mapping degraded forests deforestation and afforestation - Forest fire mapping and damage assessment - species mapping - sustainable development of forests.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Characterize the crops using Remote Sensing tools
CO2 The concepts of soil mapping through remote sensing
CO3 The evaluation of land capability for better land use planning
CO4 Acquire Knowledge in damage assessment using remote sensing
CO5 Understand the forest management using remote sensing

TEXT BOOKS:

1. "Applications of Remote Sensing in Agriculture", Elsevier Science, 2013.
2. Mutlu Ozdogan, Yang Yang., "Remote Sensing of Agricultural crops & Vegetation", Excelic press, 2020.
3. Steve E. Franklin., "Remote Sensing for Sustainable Forest Management", CRC Press, 2001.
4. Srinivas,M.G., "Remote Sensing Applications", Narosa Publishing House, 2001.
5. Andrew Rencz., "Manual of Remote Sensing. Vol.3. Edn.3. Remote Sensing for the Earth Sciences, American Society for photogrammetry and Remote sensing", John Wiley& Sons, 1999.

REFERENCES:

1. Jensen,J.R., “Remote Sensing of the Environment -An Earth Resource Perspective”. Pearson Education India; 2nd edition , 2013.
2. Mahesh Gaur, C.B. Pandey & R.K. Goyal., “Remote Sensing in Natural Resources Monitoring and Management”, Scientific Publishers, 2016.
3. Agarwal,C.S. and P.K.Garg, “Remote Sensing in Natural Resources Monitoring and Management”, WheelerPublishing, 2000.
4. Narayan,L.R.A., “Remote Sensing and its Applications”, Universities Press (India) Ltd., , 2001.
5. A.K.Singh &U.K. Chopra., “Geoinformatics Applications in Agriculture”, New India Publishing Company, 2007.
6. Peter James Eredics., “Mapping Forestry”, ESRI Press, 2010.
7. Nicholas Baghdadi, Clement Mallet, Mehrez Zribi., “QGIS & applications in Agriculture and forest”, John wiley &Sons, 2018.
8. Ravi Shankar Dwivedi., “Remote Sensing of Soils”, Springer, 017.
9. G.P.Obi Reddy, S.K.Singh., “Geospatial Technologies in Land Resource Mapping, Monitoring and Management”, Springer International Publishing, 2018.

CO-PO & PSO MAPPING: GEOMATICS FOR AGRICULTURE AND FORESTRY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	-	1	1	-	3	3	2	1
2	3	2	3	2	3	2	2	-	1	1	-	2	3	2	3
3	2	2	2	3	2	2	3	1	1	1	-	2	3	2	1
4	2	2	3	3	3	2	3	2	3	2	-	3	3	2	3
5	2	2	3	2	2	2	2	-	2	1	-	2	3	2	2
Avg.	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**-**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

GI23C05 GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS L T P C
3 0 0 3

UNIT I FUNDAMENTAL OCEANOGRAPHY AND COASTAL PROCESSES 9

Origin and formation of large water bodies - Ocean basins - Oceanic Zones - Ocean Circulations: Global thermohaline, wind driven circulations and currents - Regional Upwelling and eddy development - Waves: structure, characteristics and wave generated currents - Current meters - Tides - Coastal erosional and accretional landforms.

UNIT II SEA WATER CHARACTERISTICS AND MEASUREMENT 9

Heat, Light and sound transmission characteristics - Seawater chemistry - Ocean Biology - Marine food web - Sea water sampling and measurement - NISKIN water sampler and DSRT - CTD profiler-CTD rosette - Bathythermograph - XBT - Sediment samplers: Dredge,GRAB and deep sea coring devices.

UNIT III COASTAL HYDRODYNAMICS AND SENSING SYSTEMS 9

Sea water intrusion - Pollution dispersion - Coastal protection structures - Platforms and sensing systems - Payloads - Past and current operational satellites: NOAA, SeaSTAR, Adeos, ERS, Topex/Poseidon, QikSCAT and sentinel 3 - Indian missions: Oceansat1 and 2, SARAL and SCATSAT.

UNIT IV REMOTE SENSING RETRIEVAL AND MAPPING 9

Ocean color remote sensing - Bio-optical algorithm and SeaDAS processing - Sea surface temperature estimation - Sea surface topography mapping: RADAR altimetry and data processing - Sea level Anomaly - Scatterometry:Sea surface wind retrieval and mapping - Bathymetry - Bathymetric LiDAR.

UNIT V COASTAL MANAGEMENT APPLICATIONS 9

Coastal zone management: Critical issues, LU/LC and wetland mapping - Coastal Regulation Zones-Potential Fishing Zone Mapping - Shoreline Change Analysis - Sea Level Rise Monitoring - Cyclone tracking and damage assessment - Tsunami early warning system and damage assessment - Use of SAR images - Ship detection - Oil spill studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the basic concepts of Ocean and Coastal processes
CO2 Gain knowledge on physical, chemical and biological characteristics of sea water
CO3 Familiarize about coastal hydro dynamism and operational sensing systems
CO4 Acquire knowledge on retrieval through remote sensing methods
CO5 Analyze the applicability of retrievals for solving critical issues and develop strategic management plan

TEXT BOOKS:

1. Ian.S.Robinson., “Discovering the Ocean from Space: The unique applications of satellite oceanoghraphy”, Springer &Praxis Publishing, 2010.
2. Seelye Martin., “An Introduction to Ocean Remote Sensing”, Cambridge University Press, 2nd edition, 2014.
3. Ian.S.Robinson., “Measuring the Oceans from Space-The principles and methods of satellite Oceanoghraphy”, Springer &Praxis Publishing, 2004.

REFERENCES:

1. Robert Stewart., “Introduction to Physical Oceanography”, University Press of Florida, 2009.
2. Motoyoshi Okeda and Frederic W.Dobson., “Oceanographic applications of Remote Sensing”, CRC Press, 1995

3. Vasilis D. Valavanis., “Geographical Information System in oceanography & Fisheries”, Taylor & Francis London &NewYork, 1st edition 2007.
4. David Halpem., “Satellites, Oceanography and Society”, Elsevier Science, 2012.
5. Alasdair J.Edward, “Remote Sensing Handbook for Tropical Coastal Management”, UNESCO publishing, 2000.
6. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen., “Shoreline Management Guidelines”, Publisher: Horsholm, DHI Water & Environment, Denmark, 4th edition, 2017
7. L.S.Robinson. “Satellite Oceanography: An introduction for Oceanographers and Remote- Sensing Scientists”, John Wiley and Praxis Publishing, 1995.

CO-PO & PSO MAPPING: GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	-	-	3	-	-	-	-	-	-	3	3
2	3	2	2	3	2	-	-	3	3	3	2	2	-	-	2
3	2		3	2	3	3	3	3	2	3	3	3	3	3	3
4	3	3	2	3	3	2	3	2	3	3	3	2	3	3	-
5		3	3	3	3	3	3	3	3		3	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL V: TRANSPORTATION INFRASTRUCTURE

CE23020 TRAFFIC ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

UNIT I TRAFFIC CHARACTERISTICS 8

Traffic characteristics: Human, vehicular, and Road Characteristics- characteristics of traffic flow - uninterrupted traffic flow -interrupted traffic flow, Fundamentals of Traffic Flow, Urban Traffic problems in India.

UNIT II TRAFFIC SURVEYS 9

Traffic Surveys - Speed, journey time and delay surveys - Vehicle Volume Survey - Methods and interpretation - Origin Destination Survey - Methods and presentation - Parking Survey - Methods, interpretation and presentation - Statistical applications in traffic studies and traffic forecasting - Capacity and Level of Service

UNIT III DESIGN AND CONTROL 10

Channelization -At-grade Intersections - uncontrolled, Rotary and Signalised intersections, signal coordination - basics & types, Grade Separation - methods-merits and demerits

UNIT IV ROAD SAFETY 8

Traffic signs and road markings, Road accidents - Causes, Significance of accident data, Condition and collision diagrams - Statistical Interpretation and Analysis of accident Data, identification of blackspots- Safety countermeasures, Accident prevention, accident cost, Road Safety Audit - Overview, stages of road safety audit

UNIT V TRAFFIC MANAGEMENT 10

Traffic System Management: Regulatory Techniques- one-way street, Reversible Street, Reversible lane, turning movement restrictions, closing streets, Bus Priority Techniques - Priority manoeuvres - With-flow bus lane and contra-flow bus lane; Self- Enforcing Techniques- Demand Management Techniques (TDM) Road pricing, parking control, Tolls, Staggering of office/educational institution hours, work from home - Introduction to Intelligent Transportation Systems (ITS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the principles and standards adopted in Planning and Design of Traffic system
CO2 Apply the knowledge of science and engineering fundamentals in conducting traffic surveys and analyze the problems
CO3 Designing various types of control and regulatory measures to meet an efficient traffic network
CO4 Select appropriate methods to ensure the safety of the road users and analyze the environmental issues related to traffic network
CO5 Understand various traffic management measures in addressing the demand, pricing and ITS applications

TEXTBOOKS:

1. Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.
2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014.
3. Srinivasa Kumar, “Introduction to Traffic Engineering”, Universities Press, 2018

REFERENCES:

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011.
2. Papacosta.P.S and Prevedouros.P.D, “Transportation Engineering and Planning, third edition.
3. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.
4. C. Jotin Khisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998.
5. Hobbs. F.D. Traffic Planning and Engineering, University of Brimingham, Peragamon Press Ltd, 1994.
6. Taylor MAP and Young W, Traffic Analysis - New Technology and New Solutions, Hargreen Publishing Company , 1998.
7. Jason C.Yu Transportation Engineering, Introduction to Planning, Design and Operations, Elsevier, 1992.
8. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996.
9. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998.

CO-PO & PSO MAPPING: TRAFFIC ENGINEERING AND MANAGEMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	2	1	1	2	1	1	2	2	2	3	2	1
2	2	3	3	3	3	1	1	2	3	2	3	2	3	3	2
3	3	3	3	2	2	2	2	2	2	3	2	2	3	3	2
4	2	2	2	3	2	2	1	2	3	3	3	2	3	3	2
5	3	2	2	3	3	2	2	2	2	2	2	2	2	1	3
Avg	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23021 TRANSPORTATION PLANNING PROCESS L T P C
3 0 0 3

UNIT I TRANSPORTATION PLANNING PROCESS 8

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

UNIT II TRIP GENERATION STAGE 9

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

UNIT III TRIP DISTRIBUTION STAGE 10

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

UNIT IV MODAL SPLIT STAGE 9

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

UNIT V TRAFFIC ASSIGNMENT STAGE 9

Meaning and objective; General principles; Assignment Techniques- all-or-nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Mode-wise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the fundamentals of transportation planning process and demand estimation
CO2 Understand the trip generation concepts
CO3 Understand the trip distribution concepts
CO4 Apply the mode choice behaviour and mode split models
CO5 Understand the principles of Traffic Assignment Techniques

TEXTBOOKS:

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., 2001.
3. Michael J.Bruton, Introduction to Transportation Planning, Hutchinson, London, 1995.

REFERENCES:

1. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.
2. C. JotinKhisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998.
3. Juan de Dios Ort zar and Luis G. Willumsen, Modelling Transport, John Wiley & Sons 2001.
4. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority, 2007.
5. J D Ortuzar and L G Willumnsen. Modeling Transport. John Wiley and Sons, New York, 2011.

CO-PO & PSO MAPPING: TRANSPORTATION PLANNING PROCESS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	3	3	2	2	2	2	2	2	2	3	2	2
2	2	3	3	2	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
4	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2
5	3	3	2	2	2	2	2	2	2	2	2	1	2	3	2
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23022 URBAN AND REGIONAL PLANNING L T P C
3 0 0 3

UNIT I INTRODUCTION 7

Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas -Positive and negative impacts of urbanisation, **-** Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

UNIT II PLANNING PROCESS AND THEORIES 10

Principles of Planning -Stages in Planning Process - Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radbun Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept

UNIT III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION 10

Types of plans - Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town- Development Plan, urban nodes, Smart City Plan -Scope and Content of Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP - Case Studies.

UNIT IV PLAN IMPLEMENTATION 10

Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints - Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.

UNIT V URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS 8

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Describe basic issues in urban planning
CO2 Formulate plans for urban and rural development
CO3 Plan and analyse socio economic aspects of urban and rural planning
CO4 Design of urban development projects
CO5 Manage urban development projects

TEXTBOOKS:

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002.
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978.
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001.
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986.

REFERENCES:

1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai.
2. Thooyavan, K.R., Human Settlements - A Planning Guide to Beginners, M.A Publications, Chennai, 2005.

3. Chennai City Municipal Corporation Act, 1919 and Tamil Nadu District Municipalities Act, 1920.
4. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.
5. The Tamil Nadu Combined Development and Building Rules, 2019.
6. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, Vol I & II, Jan 2015, Govt of India, Ministry of Urban Development.
7. http://moud.gov.in

CO-PO & PSO MAPPING: URBAN AND REGIONAL PLANNING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	2	2	1	2	2	3	2	1	3	3	1
2	3	3	3	3	2	1	2	2	3	2	2	2	3	1	2
3	3	2	2	2	1	2	1	2	1	2	2	3	3	2	1
4	2	2	2	3	2	2	2	3	3	1	3	3	2	2	3
5	2	2	2	2	2	2	2	3	3	3	1	2	1	3	2
Avg.	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23023 TRANSPORT AND ENVIRONMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 8
Environmental Inventory, Environmental Assessment, Environmental Impact Assessment (EIA), Environmental Impact of Transportation Projects, Need for EIA, EIA Guidelines for Transportation Project, Historical Development.

UNIT II METHODOLOGIES 8
Elements of EIA - Screening and Scoping - Methods of Impact Analysis - Applications - Appropriate methodology.

UNIT III ENVIRONMENTAL IMPACT, PREDICTION AND ASSESSMENT 10
Prediction and Assessment of Impact of Transportation Project at various stages on water, air, noise, land acquisition and resettlement, Socio economic impact, indigenous people, aesthetics, health and safety, energy studies, IRC guidelines.

UNIT IV ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN 10
Mitigation of the impact on Natural and Man-made Environment, Health, Water, Land, Noise, Air, Public participation, Environmental Management Plan, Energy Conservation, Methods to reduce Global Warming.

UNIT V EIA CASE STUDIES 9
EIA Case Studies on Highway, Railway - EIA Case Studies on Transit Oriented Development (TOD), Compact Cities, Non- Motorised Transport (NMT)

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the student is expected to be able to:

CO1 Understand the environmental impact of transportation projects
CO2 Apply various methods of analyzing environmental impact analysis
CO3 Stage wise assessment and prediction of impact of transportation projects
CO4 Select appropriate mitigation methods and environmental management plan
CO5 Reviewing various case studies on environmental impact assessment of transport projects

TEXTBOOKS:

1. Canter, L.R., Environmental Impact Assessment, McGraw Hill, New Delhi, 1996.
2. Indian Road Congress (IRC), Environmental Impact of Highway Projects, IRC, Delhi, 1998.
3. P. Meenakshi, Elements of Environmental Science and Engineering, Prentice Hall of India, New Delhi, 2006.
4. Thirumurthy A.M., Introduction to Environmental Science and Management, Shroff Publishers, Bombay, 2005.

REFERENCES:

1. John G.Rau and David, C.Hooten, Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1995
2. James H.Banks, Introduction to Transportation Engineering, McGraw Hill Book Company, 2003.
3. World Bank, A Handbook on Roads and Environment, Vol.I and II, Washington DC, 1997
4. Priya Ranjan Trivedi, International Encyclopedia of Ecology and Environment - EIA, Indian Institute of Ecology and Environment, New Delhi, 1998
5. EIA Guidance Manual- Highway- MOEF & Govt of India, 2010
6. Manual on Norms & Standards for Environmental Clearance of large construction projects, MOEF & Govt of India.

CO-PO & PSO MAPPING: TRANSPORT AND ENVIRONMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	1	2	1	2	3	2	2
2	3	3	3	2	2	2	2	2	2	1	2	2	3	2	2
3	2	3	3	2	3	2	2	2	3	2	2	2	3	2	3
4	2	3	2	2	2	2	2	3	3	3	2	2	3	3	2
5	2	2	2	2	2	2	2	3	3	1	3	2	2	2	3
Avg.	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23024 **SMART CITIES** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 6
Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission

UNIT II SMART PHYSICAL INFRASTRUCTURE 12
Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc.

UNIT III SUSTAINABILITY AND SMART PLANNING 10
Relationship Between Sustainability and Smart planning - Place making project guidelines- Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services

UNIT IV APPLICATION OF TECHNOLOGIES IN SMART CITIES 8
Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities

UNIT V SMART CITIES PROJECT MANAGEMENT 9
Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the student is expected to be able to:
CO1 Understand the basics of urbanisation and the role of smart cities
CO2 Gain knowledge on implementation of smart physical infrastructure
CO3 Understand the role of smart planning for sustainable development
CO4 Comprehend the knowledge of technologies in smart city planning
CO5 Reviewing the case studies of smart city projects

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
4. https://smartcities.gov.in/guidelines#block-habikon-content
5. https://smartnet.niua.org/learn/library

CO-PO & PSO MAPPING: SMART CITIES

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	1	3	2	3	1	1	2	2	1	3	3	2
2	3	3	3	2	1	3	3	2	3	1	3	1	3	3	3
3	3	1	3	2	1	1	3	3	2	2	3	2	3	2	3
4	3	2	2	2	3	2	3	2	3	1	3	2	3	2	2
5	2	2	3	3	2	2	2	2	3	3	2	2	2	3	3
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23025 INTELLIGENT TRANSPORTATION SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO ITS 7

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 II 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 III ITS IN TRAFFIC MANAGEMENT 10

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 IV ITS IN TRANSPORTATION PLANNING 10

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 V ITS APPLICATION IN LOGISTICS 9

Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics-E commerce

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the fundamentals of ITS and its benefits
CO2 Gain knowledge on data collection using sensors and its applications
CO3 Acquainted with the knowledge of ITS in Traffic Management
CO4 Application of ITS in Transportation Planning
CO5 Able to gain knowledge on application of ITS in Logistics

TEXT BOOK:

1. R. Srinivasa Kumar, ”Intelligent Transportation Systems”, Universities Press P Ltd, Telangana, 2022.

REFERENCES:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992.
3. TurbanE.,”Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998.
4. Sitausu S. Mittra, "Decision Support Systems-Tools and Techniques", John Wiley, New York,1986.
5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems-Theory and Application", Springer Verlog, New York, 1987
6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

CO-PO & PSO MAPPING: INTELLIGENT TRANSPORTATION SYSTEMS

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	2	3	2	2	1	1	1	2	2	3	2	2
2	2	2	1	3	3	2	2	2	2	2	3	2	3	2	2
3	2	1	2	2	3	2	1	1	1	2	1	1	3	2	3
4	2	2	1	3	3	2	1	1	1	1	3	2	3	3	2
5	3	2	1	3	3	2	1	2	2	2	3	2	2	2	3
Avg	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL VI: ENVIRONMENT

CE23026 CLIMATE CHANGE ADAPTATION AND MITIGATION L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Atmosphere - weather and Climate - climate parameters - Temperature, Rainfall, Humidity, Wind - Global ocean circulation - El Nino and its effect - Carbon cycle

UNIT II ELEMENTS RELATED TO CLIMATE CHANGE 9

Greenhouse gases - Total carbon dioxide emissions by energy sector - industrial, commercial, transportation, residential - Impacts - air quality, hydrology, green space - Causes of global and regional climate change - Changes in patterns of temperature, precipitation and sea level rise - Greenhouse effect

UNIT III IMPACTS OF CLIMATE CHANGE 9

Effects of Climate Changes on living things - health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector - Agriculture, forestry, human health, coastal areas

UNIT IV MITIGATING CLIMATE CHANGE 9

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options - designing and implementing adaption measures - surface albedo environment- reflective roofing and reflective paving - enhancement of evapotranspiration - tree planting programme - green roofing strategies - energy conservation in buildings - energy efficiencies - carbon sequestration.

UNIT V ALTERNATE FUELS AND RENEWABLE ENERGY 9

Energy source - coal, natural gas - wind energy, hydropower, solar energy, nuclear energy, geothermal energy - biofuels - Energy policies for a cool future - Energy Audit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Identify the relationship between atmosphere and its components
CO2	Have an insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term climate change, global warming and measures to adapt and to mitigate the impacts of climate change
CO3	Analyze the impacts of climate change on environment parameters
CO4	Have an understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties
CO5	Plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy

TEXTBOOKS:

1. Ruddiman W.F, freeman W.H. and Company, “Earth’s Climate Past and Future”, 2001
2. Velma. I. Grover “Global Warming and Climate” Change. Vol. I and II. Science Publishers, 2005.
3. 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
3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

CO-PO & PSO MAPPING: CLIMATE CHANGE ADAPTATION AND MITIGATION

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	-	-	-	-	-	-	-	1	-	2	-	-	-
2	-	-	-	-	-	2	3	-	-	-	-	-	2	-	-
3	2	3	-	2	3	-	-	-	-	-	-	3	-	-	-
4	2	-	2	2	3	-	-	-	3	-	-	-	-	-	-
5	-	3	-	-	3	2	-	-	3	2	3	2	-	-	2
Avg	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**-**	**3**	**1**	**3**	**2**	**2**	**-**	**2**

• 1' = Low; '2' = Medium; '3' = High

CE23027 AIR POLLUTION CONTROL ENGINEERING L T P C
3 0 0 3

UNIT I GENERAL 9

Atmosphere as a place of disposal of pollutants - Air Pollution - Definition - Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices - Air quality management in India.

UNIT II SOURCES, CLASSIFICATION AND EFFECTS 9

Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.

UNIT III SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING 9

Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability - Adiabatic lapse rate - Wind Rose - Inversion - Wind velocity and turbulence - Plume behaviour - Dispersion of air pollutants- Air Quality Modeling.

UNIT IV AIR POLLUTION CONTROL MEASURES 9

Control - Source correction methods - Control equipments - Particulate control methods - Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices (Theory and working of equipments only).

UNIT V NOISE POLLUTION AND ITS CONTROL 9

Sources of noise - Units and Measurements of Noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise - General Control Measures - Effects of noise pollution - auditory effects, non-auditory effects. Noise Menace- Prevention and Control of Noise Pollution - Control of noise at source, control of transmission, protection of exposed person - Control of other types of Noise Sound Absorbent.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Develop the Air Pollution indices.
CO2	Demonstrate the source, classifications and effects of air pollution.
CO3	Understand the monitoring of particulate and gaseous pollutants.
CO4	Design of control equipment for Gaseous and particulate pollutants.
CO5	Understand the sources, effects and control of noise pollution

TEXTBOOKS:

1. C. S. Rao, “Environmental Pollution Control Engineering”, Wiley Eastern Limited, 2000.
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 1993
3. Dr. Y. Anjaneyulu, “Air Pollution and Control Technologies”, Allied publishers Pvt. Ltd., 2002.

REFERENCES:

1. Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000.
2. Air Pollution act, India, 1981
3. Peterson and E.Gross Jr., “Hand Book of Noise Measurement”, 5th Edition, 1963
4. Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986
5. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 1979.
6. Kenneth wark, Cecil F.Warner, “Air Pollution its Origin and Control”, Harper and Row Publishers, New York, 1981.

CO-PO & PSO MAPPING: AIR POLLUTION CONTROL ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	3	2	2	1	-	-	-	-	2	-	-
2	2	-	-	3	-	-	-	-	2	-	-	2	1	-	2
3	2	-	3	-	3	-	-	-	-	1	2	-	2	-	2
4	2	-	3	-	3	-	-	-	-	1	2	-	2	-	2
5	3	3	2	3	2	-	2	-	2	-	-	-	2	-	-
Avg	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**-**	**2**

1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23028 ENVIRONMENTAL IMPACT ASSESSMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India - types and limitations of EIA -EIA process screening- scoping - terms of reference in EIA- setting - analysis -mitigation. Cross sectoral issues - public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION 9

Matrices - networks - checklists - cost benefit analysis - analysis of alternatives - expert systems in EIA. prediction tools for EIA - mathematical modeling for impact prediction - assessment of impacts - air - water - soil - noise - biological -- cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental management plan - preparation, implementation and review - mitigation and rehabilitation plans - policy and guidelines for planning and monitoring programmes - post project audit - documentation of EIA findings - ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES 9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Carry out scoping and screening of developmental projects for environmental and social assessments
CO2	Explain different methodologies for environmental impact prediction and assessment
CO3	Asses socio-economic investigation of the environment in a project
CO4	Plan environmental impact assessments and environmental management plans
CO5	Knowledge to prepare environmental impact assessment reports for various projects

REFERENCES:

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996
2. Lawrence, D.P., "Environmental Impact Assessment - Practical solutions to recurrent problems", Wiley-Interscience, New Jersey. 2003
3. World Bank -Source book on EIA
4. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
5. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York,1996.
6. K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.

7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

CO-PO & PSO MAPPING: ENVIRONMENTAL IMPACT ASSESSMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	2	3	3	-	-	-	-	2	-	-
2	3	2	3	2	2	-	-	3	-	-	-	1	-	-	2
3	-	2	3	2	2	-	2	3	2	-	-	1	-	-	2
4	-	-	3	-	3	2	-	2	2	1	1	-	-	-	2
5	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**1**	**2**	**-**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23029 INDUSTRIAL WASTEWATER MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Industrial scenario in India- Industrial activity and Environment - Uses of Water by industry -Sources and types of industrial wastewater - Nature and Origin of Pollutants - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater monitoring and sampling - generation rates, characterization and variables -Toxicity of industrial effluents and Bioassay tests - Major issues on water quality management.

UNIT II INDUSTRIAL POLLUTION PREVENTION &WASTE MINIMISATION 9

Prevention vis a vis Control of Industrial Pollution - Benefits and Barriers - Waste management Hierarchy - Source reduction techniques - Periodic Waste Minimisation Assessments - Evaluation of Pollution Prevention Options - Cost benefit analysis - Pay-back period - Implementing & Promoting Pollution Prevention Programs in Industries.

UNIT III INDUSTRIAL WASTEWATER TREATMENT 9

Flow and Load Equalisation - Solids Separation - Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents - Precipitation, Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Electro dialysis & Evaporation -Removal of Organic Constituents - Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes - Treatability Studies.

UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT 9

Individual and Common Effluent Treatment Plants - Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse , Present status and issues - Disposal on water and land - Residuals of industrial wastewater treatment - Quantification and characteristics of Sludge - Thickening, digestion, , dewatering and disposal of sludge - Management of RO rejects.

UNIT V CASE STUDIES 9

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper - metal finishing -Sugar and Distilleries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Explain the significance of various pollutants present in water, wastewater and develop the kinetics for reactor design
CO2	Choose the relevant physico-chemical systems for effective water and wastewater treatment
CO3	Design the treatment scheme for municipal and industrial water, wastewater to meet the specific needs on residue management and up gradation of existing plants
CO4	Identify environmental issues in the society on wastewater treatment and formulate technical solutions that are economically feasible and socially acceptable

CO5	Conduct research to identify and design most appropriate treatment schemes for the emerging environmental issues on treatment systems in collaboration with municipalities, corporation, pollution control boards and industries

REFERENCES:

1. "Industrial wastewater management, treatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 2008.
2. Lawrance K.Wang, Yung . Tse Hung, Howard H.Lo and Constantine Yapijakis, “hand book of Industrial and Hazardous waste Treatment”, Second Edition, 2004.
3. Metcalf & Eddy/ AECOM, "water reuse Issues, Technologies and Applications", The Mc Graw- Hill companies, 2007.

CO-PO & PSO MAPPING: INDUSTRIAL WASTEWATER MANAGEMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	-	-	-	3	-	-	-	-	3	-	-
2	-	2	-	2	-	-	-	-	2	-	-	3	-	-	2
3	-	2	-	-	-	-	-	3	-	3	-	3	-	-	2
4	-	2	-	2	1	3	3	3	3	3	2	-	-	-	-
5	3	3	-	3	-	3	3	3	2	2	-	3	3	-	2
Avg	**3**	**2**	**-**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23030 SOLID AND HAZARDOUS WASTE MANAGEMENT L T P C
3 0 0 3

UNIT I WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS 9

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

UNIT II WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING 9

Waste sampling and characterization plan - waste generation rates and variation - physical composition, chemical and biological properties - hazardous characteristics - ignitability, corrosivity and TCLP tests -source reduction, segregation and onsite storage of wastes - waste exchange - extended producer responsibility - recycling of plastics, C&D wastes and E wastes.

UNIT III WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY 9

Door to door collection of segregated solid wastes - analysis of hauled container and stationery container collection systems - compatibility, storage, labelling and handling of hazardous wastes - principles and design of transfer and transport facilities - hazardous waste transport and manifests - mechanical processing and material separation technologies - Size reduction - size separation - density separation - magnetic separation - compaction - principles and design of material recovery facilities – physico-chemical treatment of hazardous wastes - solidification and stabilization - case studies on waste collection and material recovery

UNIT IV BIOLOGICAL AND THERMAL PROCESSING OF WASTES 9

Biological and thermo-chemical conversion technologies - composting – biomethanation - incineration - pyrolysis- plasma arc gasification -principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty By-products - operation of facilities and environmental controls - treatment of biomedical wastes - case studies and emerging waste processing technologies.

UNIT V WASTE DISPOSAL 9

Sanitary and secure landfills - components and configuration- site selection - liner and cover systems - geo-synthetic clay liners and geo-membranes - design of sanitary landfills and secure landfills- leachate collection, treatment and landfill gas management - landfill construction and operational controls - landfill closure and environmental monitoring - landfill bioreactors - rehabilitation of open dumps and biomining of dumpsites-remediation of contaminated sites- Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Explain the various functional elements of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders
CO2	Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems

CO3	Design of systems and processes to meet specified needs of waste minimization, storage, collection, transport, recycling, processing and disposal
CO4	Select appropriate methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context
CO5	Conduct research pertinent to solid and hazardous waste management and communicate effectively to different stakeholders as well as engage in independent lifelong learning

REFERENCES:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, “Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.
6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010
7. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018.
8. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management - Science and Engineering , Butterworth-Heinemann, 2016

CO-PO & PSO MAPPING: SOLID AND HAZARDOUS WASTE MANAGEMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	-	-	-	2	2	-	-	-	-	-	3	-	2
2	3	2	-	2	2	-	-	-	2	-	-	-	2	-	2
3	-	-	3	-	-	-	-	-	2	-	-	-	3	-	2
4	-	2	-	-	2	2	2	2	-	-	2	-	3	-	2
5	-	2	-	2	-	-	-	-	-	1	-	1	-	-	2
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**3**	**-**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23031 ENVIRONMENTAL LEGISLATIONS IN INDIA L T P C
3 0 0 3

UNIT I INTRODUCTION TO ENVIRONMENTAL LEGISLATIONS AND INTERNATIONAL SCENARIO 9

Significance of Environmental Law **-**International Environmental Law **-**Development of International Environmental Law **-**Source and General principals of International Environmental Law **-**General rights and obligations of States **-**General Issues of the international law related to environmental protection **-**Stockholm Declaration**-**Rio Declaration on Environment and Development**-**Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and their disposal**-** Convention of Biological Diversity**-**U.N Frame Work Convention on Climate Change**-**Montreal Protocol on Substances that deplete Ozone Layer**-**Kyoto Protocol**.**

UNIT II INDIAN CONSTITUTIONS AND ENVIRONMENTAL PROTECTION 9

Indian Constitution and Environmental Protection -Constitutional provisions concerning Environment Articles 14,15,(2) (b) 19 (e),21,31,32,38,39,42,47, 48-A,49,51,51-A: Indian Environmental Policy 2006 Administrative machinery for pollution control Common Law & Criminal Law Nuisance, Negligence, Strict liability and Absolute liability, Provisions of IPC relating to environmental problems (public nuisance u/s 268 and others (Sections 269,270,277,284,285,286,425 to 440) Section 133 of Cr.P.C.

UNIT III REMEDIES FOR ENVIRONMENTAL POLLUTION 9

Common Law Remedies/Remedies under Law of Tort - Penal Remedies - Indian Penal Code and Code of Criminal Procedure - Remedies under Constitutional Law - Writs - Public Interest Litigation - Public Liability Insurance Act, 1991 - The National Green Tribunal Act 2010

UNIT IV MAJOR INDIAN LEGISLATIONS 9

Water Act (1974) Air Act (1981) Environmental Protection Act (1986) Major Notifications, The Municipal solid Wastes (Management and Handling) Rules 2000-Bio Medical Wastes (Management and Handling) Rules 1998- Hazardous Wastes (Management and Handling Rules 1989- Environment Impact Assessment Notifications- Coastal Regulation Zone Notification- Public Hearing Notifications

UNIT V ENVIRONMENT AND DEVELOPMENT CASE LAWS 9

Meaning and concept of development - Its impact on environment; conflict between environment and development, Concept of Sustainable Development., Polluter Pay Principle, Precautionary Principle, Public Trust Doctrine. Landmark Judgments **–** Oleum gas leakage case, Rural Litigation and Entitlement Kendra, Dehradun, (1985) Supp SCC 487) Vellore Citizen Welfare Forum v. Union of India, (1996) 5SCC 647) Ganga Pollution case (1988) I SCC) S. Jagannath v. UOI (1997) SCC867) Vellore Citizens welfare forum case M.C. Mehta V. Kamalnath (1997) I SCC 388)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Understand origins and sources of environmental laws, and understand how and by whom environmental laws are made and interpreted
CO2	Understand the key principles of Indian constitutions.
CO3	Understand the National Environmental Policy and Various Legislations enacted in line with Policy
CO4	Critically analyse environmental laws within various contexts and to evaluate laws against procedural and substantive criteria

CO5	Understand and the Legal system operating in India and will be in a position to prepare compliance reports for getting environmental clearance

REFERENCES:

1. Leelakrishnan P., Environmental Law in India, Butterworths,1998
2. Leelakrishnan P., Environmental Case Book, Lexis Nexis,2000
3. Shanthakumar S. , Environmental Law - An Introduction, Butterworths,2004
4. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001

CO-PO & PSO MAPPING: ENVIRONMENTAL LEGISLATIONS IN INDIA

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	-	-	-	-	2	-	2	1	-	-	3	-	-
2	1	-	-	-	-	1	2	-	2	1	-	-	3	-	-
3	2	-	2	3	-	2	3	3	-	2	-	2	3	-	-
4	2	-	2	-	-	2	3	3	-	1	-	2	-	-	-
5	-	3	2	3	3	2	3	3	-	2	1	2	3	-	2
Avg	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**-**	**1**	**1**	**2**	**3**	**-**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL VII: WATER RESOURCES

CE23032 HYDROLOGY AND WATER RESOURCES ENGINEERING L T P C
3 0 0 3

UNIT I PRECIPITATION AND ABSTRACTIONS 9

Hydrological cycle - Meteorological measurements - Requirements, types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen and Isohyetal methods - Interception - Evaporation measurements and evaporation suppression - Infiltration-Horton"s equation - double ring infiltrometer.

UNIT II RUNOFF 9

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation - Infiltration indices - Strange"s table and SCS methods – Stage discharge relationships flow measurements - Hydrograph - Unit Hydrograph - Synthetic Unit Hydrograph.

UNIT III FLOOD AND DROUGHT 9

Natural Disasters - Flood Estimation - Frequency analysis - Flood control - Definitions of droughts - Meteorological, hydrological and agricultural droughts - IMD method - NDVI analysis - Drought Prone Area Programme (DPAP).

UNIT IV RESERVOIRS 9

Classification of reservoirs, General principles of design, site selection, spillways, elevation - area - capacity - storage estimation, sedimentation - life of reservoirs - rule curve - Estimation of Erosion/sediment yield using SWAT Model.

UNIT V GROUNDWATER AND MANAGEMENT 9

Source of groundwater - Classification and types - properties of aquifers- governing equations - Flow through layered soil - steady and unsteady flow - artificial recharge - RWH in rural and urban areas - GEC norms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Define the key drivers on water resources, hydrological processes and their integrated behaviour in catchments
CO2 Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and Hydrograph
CO3 Explain the concept of hydrological extremes such as Flood and Drought and management strategies
CO4 Describe the importance of spatial analysis of rainfall and design water storage reservoirs
CO5 Apply the concepts of groundwater for water resources management

TEXTBOOKS:

1. Subramanya K., "Engineering Hydrology", McGraw Hill Education (India) Private Limited - Fourth Edition, 2013.
2. Jaya Rami Reddy P., "Hydrology", Laxmi Publications - Third Edition, 2016.

REFERENCES:

1. David K. Todd and Larry W. Mays "Groundwater Hydrology", Wiley India Pvt Ltd, Third Edition, 2011.

2. VenTe Chow, Maidment, David R. Maidment and Lorry W. Mays, L.W. "Applied Hydrology", McGraw Hill Education, First Edition, 2017.
3. Raghunath H.M., "Hydrology: Principles, Analysis, Design, New Age International Private Limited, Fourth Edition, 2022.
4. Bhagu R. Chahar, “Groundwater hydrology”, McGraw Hill Education, First Edition, 2017.

CO-PO & PSO MAPPING: HYDROLOGY AND WATER RESOURCES ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	2	2	-	-	1	2	-	2	2	2	2
2	3	2	3	3	3	3	2	-	2	-	2	2	2	3	2
3	3	3	2	3	2	2	2	-	2	2	3	2	1	2	3
4	3	3	3	3	3	3	2	-	3	-	2	3	3	3	3
5	2	3	3	2	3	3	3	2	2	-	3	3	2	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23033 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

UNIT I THE CONCEPT OF IWRM 9

Water as a global issue: Key challenges - Definition of IWRM- Key elements and pillars of IWRM - Principles - Evolution of IWRM - IWRM relevance in water resources management - IWRM in Global, Regional and Local water partnership - Sustainable Development Goals.

UNIT II ECONOMIC AND LEGAL REGULATORY SETTINGS 9

Basic notion of law and governance: Principles of International and National law in the area of water management - Economic view of water issues: economic characteristics of water good and services - Water economic instruments - Current water pricing policy- Scope to relook pricing

UNIT III EMERGING ISSUES IN WATER MANAGEMENT 9

Emerging Issues - Drinking water management in the context of climate change - Flood - Drought - Pollution - Links between water, health and poverty: options to include water management interventions for health - Health protection and promotion in the context of IWRM - Global burden of Diseases

UNIT IV IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA 9

Ecological sustainability --Watershed development and conservation - Ecosystem regeneration - Wastewater reuse - Sustainable livelihood - Rural Development- IWRM and irrigation- Food security- Water for food production: Water footprint - Virtual water trade for achieving global water and food security.

UNIT V CONCEPTUAL FRAMEWORK OF IWRM 9

Institutional transformation - Bureaucratic reforms - Inclusive development- Capacity building -- Problems and policy issues - Solutions for effective integrated water management - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Understand the economic and legal aspects of IWRM.

CO3 Analyse the emerging issues due to climate change and make linkages between water, health and poverty.

CO4 Evaluate the impact of integrated water management on watershed, ecology, agriculture and livelihood of people.

CO5 Develop an integrated framework and arrive at effective solutions for water management problems.

TEXTBOOKS:

1. V. Thomas Cech, Principles of water resources: history, development, management and policy, 4th ed. John Wiley and Sons Inc., New York, 2018.
2. P. Mollinga, et al., Integrated Water Resources Management, Water in South AsiaVolume I, Sage Publications, 2006.

REFERENCES:

1. "Integrated Water resources Management Plan", Cap-Net, GWP- IWRM Training module [Online], March 2005. Available: https:// www.gwp.org/ contentassets/ f998a402e3ab49ea891fa49e77fba953/ iwrmp-training-manual-and-operational-guide.pdf

2. Technical Advisory Committee, “Effective Water Governance, Technical Advisory Committee Background paper No: 7”, Global water partnership, Stockholm, Sweden [Online],2003. Available:https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/07-effective-water-governance-2003-english.pdf
3. Technical Advisory Committee, “Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4”, Global water partnership, Stockholm, Sweden [Online], 2002. Available:https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/04-integrated-water-resources-management-2000-english.pdf
4. Technical Advisory Committee, “Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3”, Global water partnership, Stockholm, Sweden [Online], 1999. Available: https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/03-the-dublin-principles-for-water-as-reflected-in-a-comparatice-assessment-of-institutional-and-legal-arrangements-for-iwrm-1999.pdf

CO-PO & PSO MAPPING: INTEGRATED WATER RESOURCES MANAGEMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	2	1	1	2	2	1	2	2	1	3	2	2	1
2	2	2	2	1	1	2	2	2	2	2	2	3	2	2	1
3	3	2	2	2	1	2	3	2	2	2	1	3	2	2	1
4	3	2	2	2	1	2	3	2	3	2	2	3	2	2	2
5	2	3	3	3	1	2	3	2	3	2	2	3	2	3	3
Avg.	**3**	**2**	**2**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23034 GROUNDWATER ENGINEERING L T P C
3 0 0 3

UNIT I HYDROGEOLOGICAL PARAMETERS 9

Introduction - Water bearing Properties of Rock - Type of aquifers - Aquifer properties - permeability, specific yield, transmissivity and storage coefficient - Methods of Estimation - GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity -- Dupuit Forchheimer assumption - Steady Radial Flow into a Well

UNIT II WELL HYDRAULICS 9

Introduction to Unsteady state flow - Theis method - Jacob method - Law of Times - Theis Recovery - - Image well theory - Partial penetrations of wells - Well losses - Specific Capacity and Safe yield - Collector well and Infiltration gallery

UNIT III GROUNDWATER MANAGEMENT 9

Need for Management Model - Database for Groundwater Management - Groundwater balance study - Introduction to Mathematical model - Model Conceptualization and development- Initial and Boundary Condition - Calibration - Validation -Prediction - Sensitivity Analysis - Uncertainty

UNIT IV GROUNDWATER QUALITY 9

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

UNIT V GROUNDWATER CONSERVATION 9

Natural and Artificial recharge- Reclaimed wastewater recharge -Soil aquifer treatment (SAT) - Managed aquifer recharge(MAR) -Seawater Intrusion and Remediation - Ground water Basin management and Conjunctive use - Groundwater Protection zone delineation, Contamination source inventory and remediation schemes

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Describe the various processes of groundwater system basic, types of aquifers, aquifer parameters, movement and its potential for confined and unconfined aquifers
CO2 Apply their knowledge on well hydraulics to estimate the safe yield and groundwater potential.
CO3 Apply their knowledge on concept of groundwater model development and data base management for groundwater management
CO4 Apply the creative and innovative technique onmanagement of conservation of groundwater quality
CO5 Describe the importance of artificial recharge andgroundwater protection zone and groundwater basin management

TEXTBOOKS:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, Fourth Edition, 2021.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York,Third Edition, 2004.

REFERENCES:

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

CO-PO & PSO MAPPING: GROUNDWATER ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	1	1	1	2	3	1	1	1	2	2	2	2
2	3	3	3	2	2	2	2	3	2	2	2	2	2	3	2
3	2	2	3	2	3	2	2	2	1	3	3	2	3	3	3
4	2	2	2	1	3	3	2	3	3	3	2	3	3	3	3
5	2	2	2	2	3	3	2	3	3	3	2	3	3	3	3
Avg.	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23035 WATERSHED MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Watershed - Definition - concept - Objectives - Land Capability Classification - priority watersheds land resource regions in India.

UNIT II WATERSHED PLANNING 9

Planning principles - collection of data - present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan - selection of implementation agency - Monitoring and evaluation system.

UNIT III WATERSHED MANAGEMENT 9

Participatory Watershed Management - runoff management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands.

UNIT IV WATER CONSERVATION PRACTICES 9

In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Microcatchment water harvesting- Groundwater recharge - percolation ponds -Water harvesting -Farm pond -Supplemental irrigation-Evaporation suppression-Seepage reduction.

UNIT V WATERSHED DEVELOPMENT PROGRAMMES 9

RVP- HADP - NWDPRA - Other similar projects operated in India - Govt. of India guidelines on watershed development programmes - Watershed based rural development - infrastructure development - Use of Aerial photography and Remote sensing in watershed management-Role of NGOs in watershed development

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Recognize and interpret the concepts of a watershed and describe the land capability classification of watershed management.
CO2 Able to prepare watershed development plan.
CO3 Describe the runoff management concepts, state, design and sketch the soil conservation structures.
CO4 Illustrate the application of water conservation principle and practices.
CO5 Describe the watershed development programme, use of remote sensing in watershed management.

TEXTBOOKS:

1. Ghanashyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.
2. Suresh,R. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi, 2005.

REFERENCES:

1. Tideman,E.M.,“Watershed Management”,Omega Scientific Publishers, New Delhi,1996.
2. Tripathi R.P. and H.P.Singh, Soil erosion and conservation, Willey Eastern Ltd., New Delhi, 2002.
3. Gurmel Singh et al. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi, 2004.
4. Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 2005.

5. Suresh,R. Land and water management principles, Standard Publishers & Distributors, New Delhi, 2008.

CO-PO & PSO MAPPING: WATERSHED MANAGEMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	3	2	1	2	2	1	2	2	2	2	2	2
2	3	2	3	2	3	1	3	3	1	3	3	2	2	2	2
3	3	2	3	2	2	1	2	2	2	2	2	3	2	2	3
4	3	2	2	1	2	2	2	3	1	1	2	2	2	2	2
5	2	2	1	2	3	3	2	3	2	1	1	2	2	2	2
Avg	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23036 RAINWATER HARVESTING L T P C
3 0 0 3

UNIT I BASICS OF RWH 8

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

UNIT II HYDROLOGY AND GROUND WATER 10

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

UNIT III METHODS OF RAINWATER HARVESTING 7

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

UNIT IV DESIGN OF RAINWATER HARVESTING STRUCTURES 10

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

UNIT V MANAGEMENT OF RWH AND CASE STUDIES 10

Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems - Maintenance of RWH structures - 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

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the need and importance of water conservation through global and Indian practices of rainwater harvesting
CO2 Understand and apply the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials
CO3 Understand the various types of rainwater harvesting methods and apply it on the field
CO4 Design the various RWH structures to harvest the rainwater in surface and subsurface
CO5 Explain the difficulties of RWH, evaluation methods and maintenance through various case studies.

TEXT BOOKS:

1. H.M Raghunath “Ground Water” 3rd Edition, New Age International 2007.
2. Jayarami Reddy.P, “A Text book of Hydrology” Firewall media Publication, 2005.
3. Ramakrishnan S, “Ground Water”, Scitech Publications (India) Pvt Ltd., 2010.

REFERENCES:

1. Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water Resources Central Ground Water Board Faridabad, 2003.
2. Rainwater Harvesting: Indian Railway Institute of Civil Engineering Pune, October 2015.

3. A Manual on “Rainwater Harvesting and Conservation”: Government of India, Consultancy Service Organization Central Public Works Department, New Delhi.
4. “A Water Harvesting Manual for Urban Areas” issued by Centre for Science and Environment.
5. Empowering Village Communities for A Sustainable Water Future - A Resource Book for Jaldoots, 2019, Prepared by Central Ground Water Board, Dept. of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Govt. of India and MARVI - Managing Aquifer Recharge and Sustaining Groundwater Use through Village-level Intervention.

CO-PO & PSO MAPPING: RAINWATER HARVESTING

CO	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	2	1	1	1	2	2	2	1
2	3	3	2	2	3	2	1	1	1	1	2	2	2	2	2
3	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2
4	3	3	3	3	3	3	2	2	2	1	3	2	3	3	3
5	2	2	2	2	2	2	2	2	2	1	2	2	3	3	3
Avg.	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23037 WATER RESOURCES AND GLOBAL CLIMATE CHANGE L T P C
3 0 0 3

UNIT I WEATHER AND CLIMATE 10

Weather and Climate - Drivers of Climate change - Components of Global Climate System: Atmosphere, hydrosphere, Lithosphere, cryosphere and biosphere, atmospheric circulation- Planck's Law and Blackbody Radiation - Hadley Circulation and Climate - Global Energy Balance: Greenhouse effect; Hydrological cycle - Trophical climate, Monsoons and their role in global climate change - Ocean circulation.

UNIT II CLIMATE VARIABITLIY AND CHANGE 9

Natural Climate Variability and Change: large scale variability - El Nino, La Nina - ENSO, Teleconnections, Sun-Moon-Earth interaction - Factors Responsible for Anthropogenic Climate Change, Detection and Attribution of Climate Change; Global and Indian Scenarios - IPCC - Scenarios: SRES, RCPs and SSPs.

UNIT III VULNERABILITY ASSESSMENT 7

Need for vulnerability assessment - Conceptualization of Vulnerability - Approaches for assessment - Methods of analyzing vulnerability: econometric method, Indicator method - Types of climate models, History of climate modelling - Climate models: GCM and RCM.

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION 10

Traditional and modern harvesting system - Water-related adaptation to climate change - Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy - Adaptation, vulnerability and sustainable development Sector- specific mitigation - Carbon dioxide capture and storage (CCS) , Bio-energy crops, Biomass electricity, Hydropower, Geothermal energy, Energy use in buildings, Land-use change and management, Cropland management, Afforestation and Reforestation.

UNIT V CLIMATE CHANGE IMPACTS ON WATER RESOURCES 9

General Circulation Models - Regional climate models - Case studies on impacts of climate change on river systems, Water resources assessment, water quality, groundwater, irrigation and agriculture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Define the earth's climate system and the interaction among the subsystems of the earth components
CO2 Illustrate the basics of climate variability and change including the observations and projections
CO3 Explain the approaches and tools for vulnerability assessment.
CO4 Describe the options available for adaptation and mitigation for different sectors.
CO5 Able to assess the climate change impact on river systems, water resources, water quality, groundwater, irrigation and agriculture through case studies

TEXT BOOKS:

1. A. Barrie Pittock, Climate change, The Science, Impacts and Solutions, CSIRO Publishing, 2nd edition, 2009.

REFERENCES:

1. Sangam Shrestha, S. Mukand, Babel and Vishnu Prasad Pandey, Climate Change and Water Resources, CRC Press an imprint of the Taylor & Francis Group, 2014

2. M. John, Wallace and Peter V. Hobbs,Atmospheric Science: An Introductory Survey, Second Edition, Academic Press an imprint of Elsevier, 2006.
3. J. David Neelin, Climate Change and Climate Modeling, University Press, Cambridge, United Kingdom, 2011.
4. K. McGuffie and A. Henderson-Sellers, A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, 2005
5. T. Thomas, Warner, Numerical Weather and Climate Prediction, Cambridge University Press, New York, 2011.
6. Intergovernmental Panel on Climate Change: https://www.ipcc.ch/

CO-PO & PSO MAPPING: WATER RESOURCES AND GLOBAL CLIMATE CHANGE

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	1	1	-	2	-	1	-	2	-	-	-
2	2	3	-	2	3	2	-	2	-	1	-	2	-	-	-
3	2	2	1	2	3	2	3	2	-	2	-	3	-	-	3
4	3	3	2	2	3	2	2	2	2	2	2	3	3	3	3
5	3	3	3	2	3	3	3	3	2	2	2	3	3	3	3
Avg.	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

VERTICAL VIII: OCEAN ENGINEERING

CE23038 OCEANOGRAPHY L T P C
3 0 0 3

UNIT I PHYSICAL CEANOGRAPHY 9

Introduction to physical oceanography- Origin of Ocean and Ocean basin - Ocean dynamics and upwelling - Heat Budget - Ocean currents and circulation - waves, tides, sea level - Introduction to bottom topography - Coastal landforms - Oceanographic Methods and Instruments

UNIT II CHEMICAL OCEANOGRAPHY 9

Introduction to Chemical Oceanography - Chemical composition of seawater - Concept of Chlorinity& Salinity of sea water - Biogeochemical cycles - Trace metal geochemistry - Organic geochemistry - Tracers in the ocean - Minerals from the Sea

UNIT III BIOLOGICAL OCEANOGRAPHY 9

Photosynthesis – Primary productivity and seasonality - Phytoplankton diversity, diurnal vertical migration - Eutrophication and Harmful algal blooms (HABs) - Zooplankton and Secondary production - Nekton –Food Chain – Food Web –-Marine microbes

UNIT IV GEOLOGICAL OCEANOGRAPHY 9

Structure of Earth's interior - Evolution of the Ocean- Continental drift and plate tectonics- Geochronology - Sea level rise - Marine sediments classification - Marine microfossils.

UNIT V ENVIRONMENTAL OCEANOGRAPHY 9

Definitions and development of the DPSIR framework - Drivers and Pressures - State and Impacts-Drivers - Response(s) and Discussion - Case Studies from Indian Coastline - Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Acquire knowledge on ocean and its dynamic upwelling, topography, landforms, currents and circulation.

CO2 Summarize the chemical components of the oceans, their reactions.

CO3 Assess the relationship between marine organism and their environment.

CO4 Estimate about Continental drift and plate tectonics and different marine sediments.

CO5 Analyze the overall impact of the human activities on the sea, considering the DPSIR framework based on case studies.

TEXT BOOKS

1. David N. Thomas, “Introducing Oceanography”, Dunedin Academic Press Ltd, 2021.
2. Tom S. Garrison, “Oceanography,An Invitation to Marine Science”, 2015.
3. Joseph M. Moran, “Ocean Studies: Introduction to Oceanography”, 2011.
4. John A. Knauss, “Introduction to Physical Oceanography” 3rd Edition, 2016.

REFERENCES:

1. Garrison, Tom S, “Oceanography: an invitation to marine science”, Cengage Learning, 2015.
2. Emerson, Steven R., and Roberta C. Hamme. “Chemical Oceanography”, CambridgeUniversity Press, 2022.
3. Webb, Paul, “Introduction to oceanography”, Roger Williams University, 2021.
4. Beer, Tom, “Environmental oceanography”, CRC Press 2nd Edition, 2017.
5. Knauss, John A, and Newell Garfield, “Introduction to physical oceanography”, WavelandPress 3rd Edition, 2016.

CO-PO & PSO MAPPING: OCEANOGRAPHY

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3			2	2	2				3		2	1	3	
2	3			2	2	2		3		3		2	3	3	
3	3			2	2	2		2		2		2	2	3	
4	3			2	2	2		3		2		2	3	3	
5	3	3	3	3	2	2		3		3		2	3	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**		**3**		**2**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

CE23039 OCEAN WAVE DYNAMICS L T P C
3 0 0 3

UNIT I CONSERVATION OF MASS, MOMENTUM AND ENERGY 7

Conservation of mass, momentum, and Energy; Euler Equation – Bernoullis Equation. Potential and Stream function.

UNIT II CLASSIFICATION OF OCEAN WAVES 9

Introduction - wind and waves - Sea and Swell - Introduction to small amplitude wave theory - Mechanics of water waves - Linear (Airy) wave theory: Governing Equation, Boundary Conditions and solutions, Dispersion relation, use of wave tables, Constancy of wave period, Introduction to Tsunami

UNIT III WAVE KINEMATICS 9

Wave celerity, water particle velocities, accelerations, displacements, and pressures. Approximations for deep and shallow water conditions. Integral properties of waves: Mass flux, Energy and energy flux, Group speed.

UNIT IV WAVE TRANSFORMATIONS 8

Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number

UNIT V WAVE ANALYSIS AND WAVE PREDICTION 12

Short term wave analysis- short term wave Height Distribution – Wave period Distribution - Time and Frequency domain Analysis of Wave Records - wave energy spectra –Long term wave analysis – Gumbel Distribution – Weibull Distribution - Statistics analysis of grouped wave data.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the concept of mass, momentum, and wave energy transformations.
CO2 Estimate the different classification of ocean waves
CO3 Explain the wave kinematics along with its properties.
CO4 Understand the principles of wave transformation.
CO5 Analyse and forecast the long term and short term waves.

TEXT BOOK :

1. Boccotti P, “Wave mechanics and wave loads on marine structures”, Butterworth-Heinemann an imprint of Elsevier, 2nd edition, 2015.
2. Dominic Reeve, Andrew Chadwick, Christopher Fleming, “Coastal Engineering: Processes, Theory and Design Practice”, Taylor & Francis Group, CRC Press, 3rd edition, 2018.
3. Dean, R.G. and Dalrymple, R.A., “Water wave mechanics for Engineers and Scientists”, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, Volume 4, 1994.
4. Mani J S, “Coastal Engineering”, PHI Learning Private Limited, 2nd Edition, 2018.

REFERENCES:

1. Pecher, Arthur, and Jens Peter Kofoed, “ Handbook of ocean wave energy”, Springer Nature Volume 7, 2017.
2. Sundar, V. “Ocean wave Mechanics- Applications in Marine Structures”, Edition: 1, 2016.
3. Washington, D.C. : U.S. Army Corps of Engineers, “Coastal engineering manual”, 2002.

CO-PO & PSO MAPPING: OCEAN WAVE DYNAMICS

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3						2					3	2	3	3
2	3	2				3		3			2	2	2	3	3
3	3	3	2		2	2		2			3	2	3	3	2
4	3	3	3		3	3		3		2	2	3	3	3	2
5	3	3	3	3	3	3		3	2		3	3	3	3	3
Avg.	3	3	3	3	3	3	2	3	2	2	2	2	3	3	2

• 1' = Low; '2' = Medium; '3' = High

CE23040 SEA SURVEYING AND MONITORING L T P C
3 0 0 3

UNIT I BASICS OF COASTAL AND HYDROGRPAHIC SURVEYING 6

Large scale coastal land surveying – Modern instrumentation – Hydrographic surveys for coastal regions – Fields of applications and uses – Standard specifications and zones of confidence for hydrographic surveys – Nautical charts – Nautical Information Systems

UNIT II PRINCIPLES OF POSITIONING –BASICS 9

Shape of the Earth — Ellipsoid — Local Sphere — Geoid Datum — Types of Datum — Horizontal andVertical Datum – Coordinate Systems – Principles of Cartography – Projections – Different types – Universal Transverse Mercator (UTM) projection.

UNIT III PRINCIPLES OF POSITIONING – INSTRUMENTATION 10

Survey of India –Positioning Methods – Horizontal Control Methods – VerticalControl Methods – Instruments used – Topographic surveying applied to hydrography- Global Positioning systems (GPS) and its types –– Use of modern electronic surveying instruments – Coastline delineation – Coastal and Harbor Surveys

UNIT IV DEPTH DETERMINATION AND SEA FEATURES DETECTION 10

Fundamentals of acoustic wave propagation in ocean waters - Sound velocity computation - Bathymetry Surveying equipment: echosounder, single beam and multibeam sonar, Seismic - sub-bottom profiler, side scan sonar and tracking equipment

UNIT V TIDAL AND CURRENT MEASUREMENTS 10

Principles of Tides and Water Levels - Astronomical Tide Producing Forces - Tidal Characteristics - Non-tidal water level variations - Tide and water level Datum - Principles of Tidal Currents - Measurements and Prediction of Currents and wave measurements.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Acquire knowledge on basics of coastal and hydrographic surveying

CO2 Understand the basics information of shapes of earth, coordinate systems, cartography, Projection and its types.

CO3 Apply the modern electronic instruments for sea and coastal surveying

CO4 Explain the modern instrumentational methods for depth determination and sea features detection .

CO5 Extend the knowledge of Tides and currents

TEXT BOOKS :

1. Ask, T., “Handbook of Marine Surveying”, Sheridan House, 2nd edition, 2007.
2. Ingham, A. E., “Hydrography for the Surveyor and Engineer”, 3rd Edition revised by Abbott V. J., Blackwell Science, 1992.
3. Loweth, R. P. “Manual of Offshore Surveying for Geoscientists and Engineers” Chapman & Hall,1997.
4. Donald B. Thomson, David E. Wells & W. H. Falkenberg , “An Introduction to Hydrographic Surveying”, 1981.
5. J. Paul Guyer, P.E., R.A., “An Introduction to an Overview of Hydrographic Survey Techniques”, Publisher: Guyer Partners 2020.

REFERENCES:

1. Ghilani, C.D. and Wolf, P.R., "Elementary Surveying: An Introduction to Geomatics", Published by Prentice Hall 13th Edition, 2011.
2. Kennish, M.J, "Practical Handbook of Marine Science", CRC Press 4th Edition, 2001.
3. Brekhovskikh, L.M. and Lysanov, Y.P, "Fundamentals of Ocean Acoustics", Springer 3rd edition,2004.
4. de Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A., Hydrography, Delft University Press, The Netherlands, 2002.
5. International Hydrographic Organisation, "IHO Standards for Hydrographic Surveying" (S44), IHB Monaco, 1998

CO-PO & PSO MAPPING: SEA SURVEYING AND MONITORING

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3									3		3	1		
2	3									3		2	3	3	
3	3	1	1	3	3	2		2		2		2	2	3	3
4	3	1	1	3	3	3		3					3	3	2
5	3	1	1	3	3	3		3		3		3	3	3	3
Avg.	**3**	**1**	**1**	**3**	**3**	**3**		**3**		**3**		**3**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

CE23041 PORT AND HARBOUR ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Ports and harbors: Classification of ports & harbours – Port and harbor planning and layout – Meteorological, hydrographic, and oceanographic data requirements and measurements for port and harbor design.

UNIT II PORT AND HARBOUR LAYOUT OPERATIONS 9

Port and harbour layout for vessels navigation and cargo handling- port buildings, navigation channels – land reclamation – Dredging -equipment, navigation improvement, pipelines, and cables.

UNIT III PORT FACILITIES 9

Port Development-Planning-Building Facilities, Transit Sheds, Warehouses, Other Port Facilities-services for shipping terminals-inland port facilities planning, Supporting facilities-Railways-Roads-Air communication-Telephones-Fresh water supply-Power supply-Harbour crafts-Internal roads, rail tracks and pavements.

UNIT IV DESIGN OF PORT 9

Types and classification of ports and harbours in India, Natural ports and manmade ports, major ports, minor ports; Design of port infrastructures with regards to cargo handling, cargo storage and integrated transport of goods.

UNIT V DESIGN OF HARBOUR 9

Design harbour Infrastructures - design of break water - shore attached and offshore breakwaters design - harbour basin design, approach channel design, turning basin design, with regards to cargo and passenger terminals

TOTAL: 45 PERIODS

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1 Understand the classification of port and harbor and study about the data requirement and measurements for port and harbour structures.

CO2 Discuss the layout operations for vessel navigation and cargo handling.

CO3 Describe the essential facilities needed in port.

CO4 Explain the design guidelines for port structure.

CO5 Explain the design guidelines for harbour structure.

TEXTBOOKS

1. Bruun, Per. Port engineering: vol. 1. Harbor planning, breakwaters, and marine terminals.1989.
2. A. D. Quinn, “Design and Construction of Port and Marine Structures”, McGraw-Hill Book Company, 2nd Edition, 1972.
3. C. A. Thoresen, “Port Design- Guidelines and recommendations”, Tapir Publications, Edition 1, 1988. 186
4. J. W. Gaythwaite, Van Nostrand , “Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels” 1990
5. Muir Wood, A.M., and Fleming. C.A., “Coastal Hydraulics Sea and Inland Port Structures”, 1st Edition, Hallstead Press, 2002.

CO-PO & PSO MAPPING: PORT AND HARBOUR ENGINEERING

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3			2							2		2	2	2
2	3			2											
3	3			3	2				2	3	3		2	2	1
4	3	3	3	2	2	2	2	2	2	2	1	2	3	3	2
5	3	3	3	2	2	2	2	2	2	2	1	2	3	3	2
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1' = Low; '2' = Medium; '3' = High

CE23042 COASTAL ENGINEERING L T P C
3 0 0 3

UNIT I COASTAL ENVIRONMENT 9

Introduction - Coastal morphology and landforms - Beach, coast and shore -wind, waves, Sea and Swell – Tides & currents - Coastal features - Coastal Zonation -Inshore and Offshore Areas - Mean Sea level .

UNIT II WAVES DYNAMICS 9

Basics of waves - Classification - Wave Theory - Physical Characteristics of different types of waves - Linear Wave Theory - Wave celerity - Velocities -Accelerations - Displacements - Wave dynamics in shallow and deep water conditions.

UNIT III NEARSHORE WAVE TRANSFORMATION 9

Introduction to non- linear waves and their properties - Waves in shallow waters : Wave Shoaling, Refraction, Diffraction and Reflection – Wave breaking - Interaction currents and waves- near shore currents- wave run-up and overtopping -

UNIT IV SEDIMENT DYNAMICS AND TRANSPORT 9

Introduction to sediments, Sediment Analysis, types and sizes of sediments, sedimentation processes, sediment Supply & movement - Cross-shore sediment transport - Long shore sediment transport - Shoreline Changes - Shoreline Evolution - Erosion & Accretion.

UNIT V SHORE PROTECTION 9

Design of shore defense structures; Hard Engineering measures - Sea walls, Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures — Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation, Bioshields - Case studies

TOTAL:45 PERIODS

COURSE OUTCOMES:

On successfully completing this course unit, students will be able to:

CO1 Understand the basic concepts of coastal environment.

CO2 Calculate sea state parameters (wave height, wave period, water levels) in shallow and deep water conditions.

CO3 knowledge on the principles of near-shore wave transformation.

CO4 Analysis the sediment and its transport processes.

CO5 Evaluate measures to protect beaches from erosion due to waves and currents.

TEXTBOOKS:

1. Kamphuis, J.W., Introduction to coastal engineering and management, 2000
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
3. Mani J.S, “Coastal Engineering book”, PHI Publishing Company, 2nd Edition, 2021.

REFERENCES:

1. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., New York, 1978.
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, NewYork, 1978.
3. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC,2006.

CO-PO & PSO MAPPING: COASTAL ENGINEERING

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1							2			3		3	1		
2	3	3	3					3		3		2	3	3	
3	3	3	2		2	2		2		2		2	2	3	
4	3	3	3		3	3		3				2	3	3	2
5	3	3	3	3	3	3		3		3		3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**		**3**		**2**	**3**	**3**	**2**

• 1' = Low; '2' = Medium; '3' = High

CE23043	OFFSHORE TECHNOLOGY	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO OFFSHORE ENVIRONMENT 9

Ocean winds-characterization of wind regime-wind velocity profile, Ocean waves-wave parameters-Introduction to Airy's wave theory and its applications-brief about time and frequency domain analysis, brief introduction about ocean currents-tides, seaquakes, Ice environment, Ice-sea interactions.

UNIT II TYPES OF OFFSHORE STRUCTURES 9

Offshore Structures-need for offshore structures. Types of Offshore Structures -components - materials used-design parameters-suitable environment conditions –construction practices – drawbacks - EIA for Offshore structures.

UNIT III FORCES ON OFFSHORE STRUCTURES 9

Introduction-Permanent loads-operating loads. Environmental forces-wind force-wave force-current force-seaquake force-Ice force. Force due to tides - Marine growth - Use of API RP 2A guidelines.

UNIT IV SUBMARINE PIPELINES AND RISERS 9

Pipeline elements-types of pipelines-laying method-materials. Pipe wall thickness verification. Pipeline stability. Design using DNV 81 code.

UNIT V INTROCUTION TO MARINESEDIMENTS 9

Planning and site exploration - marine sediments classification and its properties-Plasticity-Fall velocity-Influence of shape on fall velocity-Effect of temperature-Effect of Turbulence-Permeability and porosity- Liquefaction of Sands

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the offshore environment and technical terms associated with it.
CO2 Explain the types and choose suitable offshore structures according to environmental conditions
CO3 Investigate various types of forces acting on the offshore structures
CO4 Adapt appropriate codes to design the submarine pipelines
CO5 Discuss about the properties of marine sediments.

TEXT BOOKS

1. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
2. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.
3. Reddy, D. V and Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ. Co.1991

REFERENCES:

1. B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.
2. Clauss, G, Lehmann, E &Ostergaard, C, Offshore Structures, Vol. 1 & 2, Springer-Verlag, 1992.
3. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.
4. McClelland, B and Reifel, M. D., Planning and Design of fixed Offshore Platforms, Van Nostrand, 1986.
5. DNV-RP-B101-Corrosion Protection of Floating Protection and Storage Units, 2007.
6. API RP 2A. Planning, Designing and Constructing Fixed Offshore Platforms, API. 2000.

CO-PO & PSO MAPPING: OFFSHORE TECHNOLOGY

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	1	2	2	1	2	1	1	3	3	2	2
2	3	2	1	1	1	2	2	1	2	1	2	3	3	2	2
3	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
4	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
5	3	2	1	1	2	2	2	1	2	1	1	3	3	2	2
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1' = Low; '2' = Medium; '3' = High

OPEN ELECTIVE II
(OFFERED TO OTHER DEPARTMENTS)

CE23901 SUSTAINABLE ENGINEERING L T P C
3 0 0 3

UNIT I DERIVES, ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS AND RESILIENCY 9

Emerging Challenges - Sustainability - Sustainable engineering - Environmental Concerns - Social, economic and legal issues - Availability and Depletion of natural resources - Disaster resiliency.

UNIT II SUSTAINABILITY METRICS AND ASSESSMENT TOOLS 9

Sustainability indicators - Metrics - Assessment tools - Material flow analysis and material budget - Carbon foot print analysis - Life cycle assessment -Streamlined -Economic input-output - Environmental health risk assessment -Other emerging tools.

UNIT III SUSTAINABILITY ENGINEERING PRACTICE 9

Sustainable energy engineering - Waste management - Green and sustainable buildings - Civil Infrastructure - Remediation of contaminated sites - Climate geo-engineering.

UNIT IV SUSTAINABILITY ENGINEERING APPLICATIONS IN ENVIRONMENTAL AND CHEMICAL ENGINEERING PROJECTS 9

Food scrap land filling verses composting -Adsorbent removal of Arsenic from groundwater - Conventional verses Biocover landfill cover system-Algae biomass deepwell reactors verses open pond system -Remedial alternatives for pesticide content.

UNIT V SUSTAINABILITY ENGINEERING APPLICATIONS IN CIVIL AND MATERIALS ENGINEERING SUSTAINABILITYPROJECTS 9

Comparison of two buildings design for an electric bus system - Retaining walls - Shear walls - Retrofitting techniques - Two alternate water pipelines - Sustainable rural electrification - Solar PV power generation system proposal (CAPEX cost) - Diesel power generation system proposal (APEX cost and CAPEX cost).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Provides a complete and sensible understanding of the important concepts of sustainability, sustainable engineering and resiliency
CO2 Measure sustainability by applying various sustainability metrics and assessment tools
CO3 Explains different sustainable engineering practices in waste management and remediation of contaminated sites and climate Geo engineering
CO4 Apply the suitable sustainability engineering practices in environmental and chemical engineering projects
CO5 Apply the suitable sustainability engineering practices in civil and materials engineering projects

REFERENCES:

1. Krishna R. Reddy, Claudio Cameselle and Jeffrey A. Adams Sustainable Engineering: Drivers, Metrics, Tools, and Applications, 1st Edition, Wiley, 2019.
2. SrinivasVasamand K. JagannadhaRao, Sustainable Engineering, 1st Edition, S.K. Kataria& Sons, 2021.

3. David T. Allen and David R.Shonnard, Sustainable engineering : concepts, design, and case studies, 1st Edition, Prentice Hall, Upper Saddle River, NJ, 2012.
4. R.L. Rag and Lekshmi Dinachandran Remesh , Introduction to Sustainable Engineering, Prentice Hall India Pvt., Limited, 2016.
5. Andrew Braham and Sadie Casillas, Fundamentals of Sustainability in Civil Engineering, 2nd Edition CRC Press, 2020.

CO-PO & PSO MAPPING: SUSTAINABLE ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	-	-	3	2	-	-	-	2	3	3	3
2	-	3	-	2	3	-	3	-	-	-	-	-	3	3	3
3	3	-	3	-	2	-	3	-	-	-	-	-	3	3	3
4	-	2	3	-	-	2	3	-	-	-	2	-	3	3	3
5	-	2	3	-	-	2	3	-	-	-	2	-	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

• 1' = Low; '2' = Medium; '3' = High

CE23902 **WASTE TO ENERGY** **L T P C**
3 0 0 3

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Waste as a resource and alternate energy source - Classification of waste as fuel - Agro based, Forest residue, Domestic waste and Industrial waste - MSW - Conversion devices - Incinerators, gasifiers, digestors - Plasma Arc Technology and other new technologies.

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis - Types, slow fast - Manufacture of charcoal - Methods - Yields and application - Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers - Fixed bed system - Downdraft and updraft gasifiers - Fluidized bed gasifiers - Gasifier burner arrangement for thermal heating - Gasifier engine arrangement and electrical power.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves - Improved chullahs, types, some exotic designs - Fixed bed combustors, types - Inclined grate combustors - Fluidized bed combustors - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Basics concepts of circular economy based on organics - Properties of biogas (calorific value and composition) - Biomass conversion processes - Thermo chemical conversion - Direct combustion - Biomass gasification - Pyrolysis and liquefaction - Biochemical conversion - Anaerobic digestion - Types of biogas Plants - Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the various types of wastes from which energy can be generated
CO2 Gain knowledge on biomass pyrolysis process and its applications
CO3 Develop knowledge on various types of biomass gasifiers and their operations
CO4 Gain knowledge on biomass combustors and its applications on generating energy
CO5 Understand the principles of bio-energy systems and their features

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1989.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

CO-PO & PSO MAPPING: WASTE TO ENERGY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	3	2	2	1	2	2	1	2	1	3	3	3
2	3	2	3	3	2	2	2	2	2	1	2	2	3	3	3
3	3	2	3	3	2	1	1	1	2	2	1	1	3	3	3
4	3	2	3	3	2	2	2	2	1	2	2	2	3	3	3
5	3	2	3	3	2	2	2	2	1	2	2	2	3	3	3
Avg.	3	2	3	3	2	2	2	2	2	2	2	2	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23903 **HYDROLOGY** **L T P C**
3 0 0 3

UNIT I ATMOSPHERIC WATER SYSTEM 9

Hydrological cycle - Climate - Weather - Layers in atmosphere - Types and forms of precipitation - Hydro meteorological measurements - Cyclones - Fonts - Wind - Monsoon - Clouds - Requirements of Precipitation.

UNIT II HYDROLOGIC PROCESSES 9

Rainfall - Types of rain gauges - Adequacy of network - Spatial analysis of rainfall data using Thiessen and Isohyetal method - Frequency and intensity/duration analysis - Consistency - Missing data - Abstractions - Infiltration - Evaporation - Interception - Process, estimation and measurement - Depression and detention storages.

UNIT III RUNOFF 9

Watershed, catchment and basin - Catchment characteristics - Factors affecting runoff - Runoff estimation using empirical - Strange's table and SCS methods - Stage discharge relationships - Flow measurements - Hydrograph - Unit hydrograph.

UNIT IV GROUNDWATER AND RAIN WATER HARVESTING 9

Origin - Classification and properties of aquifers - Groundwater potential - Darcy's law - Importance - RWH in rural and urban areas - RWH from building roof and open areas - Direct storage sumps - RWH structures.

UNIT V FLOODS AND DROUGHTS 9

Natural disasters - Flood estimation - Frequency analysis - Flood control - Definitions of droughts - Meteorological, hydrological and agricultural droughts - IMD method - NDVI analysis - Drought Prone Areas Program (DPAP).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Define the key drivers on atmospheric water system and their integrated behaviour
CO2 Apply the knowledge of hydrological models to surface water problems and basin characteristics
CO3 Explain the concept of runoff and hydrograph
CO4 Apply the concepts of groundwater and rainwater harvesting potential for water resources management
CO5 Describe the importance of hydrological extremes such as flood and drought and management strategies

TEXT BOOKS:

1. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, 2013.
2. Jayarami Reddy P., "Hydrology", Laxmi Publications, Third Edition, 2016.

REFERENCES:

1. David Keith Todd, "Groundwater Hydrology", John Wiley & Sons Inc., 2007.
2. Ven Te Chow, Maidment D.R. and Mays L. W., "Applied Hydrology", McGraw Hill International Book Company, 2010.
3. Raghunath H. M., "Hydrology", Wiley Eastern Ltd., 2004.

CO-PO & PSO MAPPING: HYDROLOGY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	1	2	1	2	2	1	2	1	2	3	3	3
2	3	3	3	3	3	2	1	3	1	2	2	2	3	3	3
3	3	3	3	3	3	3	2	3	3	2	3	2	3	3	3
4	3	3	3	3	3	3	1	3	2	2	2	3	3	3	3
5	2	2	2	2	3	2	2	2	2	3	3	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

INDUSTRY ORIENTED COURSES

BUILDING INFORMATION MODELING IN CONSTRUCTION

Course Code		**Course type**	**Hybrid/One Credit**
Hours/week: L - T- P	1-0-0		
Total Contact Hours	Self-paced learning/Hybrid – 15hrs		

Recommended Semester	**BE/B.Tech –III, IV,V, VI, VII & VIII, ME/M.Tech- I & II**

Course learning objectives	
1.	The concept of Building Information Modeling
2.	The workflow followed in industry during creation of BIM 3D model which includes building the discipline-based model and create the federated models.
3.	The Discipline based modeling of a building using Revit tool.
4.	The detection of clashes during design co-ordination using software tool.
5.	The knowledge on Common Data Environment (CDE) & Level of Development (LOD) in BIM workflows.

Pre-requisites for the course	Basic knowledge about Engineering Graphics fundamentals is preferred

Unit – I Introduction to BIM	
Building Information Modeling - Evolution of Engineering from 2D drawings to BIM Model, Isometricview – Examples and Limitation, Building Information Modeling – Introduction & Process, Application. Design Authoring – Concepts and workflow, Introduction to stages of BIM Modeling process as per ISO19650. Introduction to Revit, User Interface in Revit - Architecture, Structure, Systems, Insert, Annotate, View,Manage, Modify.	

Unit – II Design Authoring in Revit Tool	
Revit Architecture – File setup, creating levels and grids, Modeling Architectural elements, Schedulesand Annotation, Sheet creation, Parameter creation. Revit Structure - File setup, creating levels and grids, modeling structural elements, Schedules andAnnotation, Sheet creation, Parameter creation, Remove warnings.	

Unit – III Federated Model and Engineering Analysis	
Federated model – Concept, Strategy and benefits, Linking of Revit files and Reload of links in Revit, Exporting file formats, Rendering and Animation. Engineering Analysis – Structural Analysis, Energy Analysis, Lighting Analysis, Design Review	

Unit - IV Visualization & Clash check	
Views in BIM Model, Visualization Modes, Walkthrough of the Model, Fly through the model, Layers & Properties, Concept of viewpoints, Sectioning and Visualization through Tablet and Mobile, Concept of BIM Kiosk & BIM Rooms, Visualization through Augment Reality (AR), Virtual Reality (VR) & Mixed Reality (MR) Clash Check – Types, Clash avoidance process, Clash Detection Process, Clash Detection Priority Matrix and Report generation, Clash Detection Rules, Report, Grouping, Clash Detection using software tool.	

Unit – V Common Data Environment (CDE) & Level Of Development (LOD)
Documentation and CDE (Common Data Environment) - Concept of Cloud Computing, Concept and Application of CDE, Setting up the workflow and process for CDE. Concept of LOD (Level of Development), preparation of LOD matrix and Progression matrix, LOD- Chart, Matrix, and Model Progression Matrix

Books	
	Reference Books:
1.	ISO 19650 Building Information Modelling (BIM)
	E-resources
1.	L&T EduTech LMS

Software		
S.No	Software Taught	Versions available(Student/Paid/Free)
1	Autodesk Revit	2023 (Student version – Free for 3 years)
S.No	Software Required	Versions available(Student/Paid/Free)
1	Autodesk Revit	2023 (Student version – Free for 3 years)

Course delivery methods		Assessment methods	
1.	Self-paced learning	1.	Assessment (MCQ)
2.	Online/Physical expert sessions	2.	

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Interpret** the basic principles of BIM evolution and concept of BIM in lifecycle of project	Un		
2.	**Understand** the workflows of Design authoring followed in industry during creation of 3D model	Un		
3.	**Create** the discipline-based model of the building using Revit Software tool	Cr		
4.	**Evaluate** the developed model for Clashes and rectify them using software tool.	Ev		
5.	**Apply** LOD concepts to different stages of BIM model development and project documentation.	Ap		

Scheme of Continuous Internal Evaluation (CIE):

Components	Assessments –I,II,III	Learning score	Total Marks
Marks	MCQ – 20+20+50	10	100

Rubrics: Levels	**Target**
<40	Participation
41-70	Completion
71 - 100	First class

METRO RAIL TRANSPORTATION DESIGN & CONSTRUCTION

Course Code		**Course type**	**Hybrid / One credit**
Hours/week: L - T- P	1-0-0		
Total Contact Hours	Self-paced learning/Hybrid – 15 hours		

Recommended Semester	**B.E/B.Tech – V,VI,VII,VIII**

	Course learning objectives
	This course aims to
1.	Elaborate on the salient features and types of Transit oriented development and its significance
2.	Explain the planning, Analysis, design and execution of elevated and underground Metro viaducts, tunnels and stations
3.	Explain the design and Analysis of Earth retaining structures used in Metro systems
4	Introduce the future trends and technologies in Transportation systems.

Pre-requisites for the course	**NA**

Unit – I Introduction to Mass Rapid Transit System (MRTS) and Planning of Metros	
Overview of Metro, Transit Oriented Development, Feasibility Study for MRTS Project, Sustainable and Smart Technologies, Recent Advancements & Future Technologies (High Speed Rail Technology, 'Maglev & Ground Effect Trains etc.). Basic Interfacing Principles – Alignment, Urban level planning, constraints and restrictions, Building Information Modelling in Metros, HVAC Systems, Tunnel Ventilation System, Public Health Engineering, Fire Alarm System etc.	

Unit – II Construction technology and Quality Control	
Introduction to Contracts, Overview of FIDIC standards, Introduction to Quality Systems, Knowledge check. Precasting Yard Development, Types of Precast Super Structure, Precast Mould development, Formwork System Overview, introduction to Precast Erection, Superstructure launching Methods, Obligatory Spans, substructure and foundation Construction Methodology, Challenges in Foundation Construction	

Unit – III Elevated Metro stations and Viaducts	
Alignment / Span configuration of elevated structures, Soil condition and type of foundations, Substructure system, Choosing type of Pier based on alignment profile, Rail / Over Head Equipment mast, Station overall layout, Pier arm - spine wing / cantilever and Platform-precast/cast-in-situ system.	

Unit - IV. Design and Analysis of Elevated Metro Stations	
Overview of Elevated station, Analysis and Design, Spine beam method, Design of station components, Loads and introduction to IRC/IRS Codes, 'Analysis and Design of superstructure, Substructure and foundation, 'Introduction to Modelling Software - STAAD Pro .	

Unit – V Earth Retaining systems and Underground Metro Stations	
Underground Stations and its configurations, Shoring Systems, supporting systems, Construction Methodology (Bottom Up method/ Top Down method), Earth retaining structures, Secant pile wall design, Guide walls, Introduction to Loads, Load combinations, Fire resistant criteria and Floatation check, 2D & 3D model generation, SOD restrictions & Element sizing for UG Stations, Design of all the components of UG station.	

Books	
	Reference Books:
1.	Indian Standard code- IS 456
	E-resources
1.	E-learning content on L&T EduTech Platform

Software		
S.No	Software Taught	Versions available(Student/Paid/Free)
1	STAAD.Pro	Student version
2	Wallap	Paid version

Course delivery methods		**Assessment methods**	
1.	Self-paced learning	1.	Assessment (MCQ)
2.	Online/Physical expert sessions		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Create** the basic layout of elevated and underground metro stations as per laid down codes and regulations	**Cr**		
2	**Interpret** design recommendations and Codes of Practice for Elevated and Underground Metros	**Un**		
3	**Design** the earth retaining systems for the excavations of underground stations	**Ap**		
4	**Select** suitable construction practices for underground and elevated metros	**An**		
5.	**Comprehend** the MEP systems used in metros and latest trends in transportation systems	**Un**		

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Assessments –I,II,III	Learning score	Total Marks
Marks	MCQ – 20+20+50	10	100

Rubrics: Levels	**Target**
<40	Participation
41-70	Completion
71 - 100	First class

OPPORTUNITIES IN HOUSING SECTOR

Course Code		**Course type**	**Hybrid / One credit**
Hours/week: L - T- P	1-0-0		
Total Contact Hours	Self-paced learning/Hybrid – 15 hours		

Recommended Semester	**B.E/B.Tech – V,VI,VII,VIII**

Course learning objectives	
	This course helps the students to
1.	Understand the job opportunities in the housing sector
2.	Acquire knowledge on the building codes and design of basic structural elements
3.	Know the different foundation types and select appropriate type matching the soil report
4.	Understand the structural drawings and interpret the essential design data
5.	Calculate the quantity and rates for creation of better construction estimates

Pre-requisites for the course	**NA**

Unit – I Job Opportunities- Introduction	3 hrs
Jobs in small/unorganized sector- jobs in reputed companies- Builder/contractor- Understanding Real Estate Economics- Outright Vs JVs - GST, TDS- Income tax	

Unit – II Building Codes and Basic concept of RCC	3 hrs
TNCBR Building Codes and Enforcement, Client Drawing, Pre-DCR Approval Drawing- RCC structural members- Slab Design, Beam Design, Column Design, Footing Design, Approximate Steel Quantities, Evolving Structural Layouts- Slab Arrangement- Beam Arrangement- Column Positioning.	

Unit – III Basics of Foundation Design	3 hrs
Soil Report Interpretation- Choice of Foundation- Raft Foundation- Pile Foundation- Under reamed Piles.	

Unit – IV Interpretation of Structural Drawings	3 hrs
Super Structure- Plan, Elevation, Cross Section Drawing, Lintel Loft Sunshade Drawing, Roof Centerline Drawing, Others- Perspective Drawing, Staircase Drawing, Sill Level Drawing, Outside Drawing, Joinery Drawing, Flooring Drawing, Compound Wall Drawing	

Unit – V Deciphering the Building Estimates	3 hrs
Detailed Quantity Estimate- Rate Analysis- Abstract Quantity Estimate- Sequence of Work- Project Planning- Rain water harvesting	

Books	
	Reference Books:
1.	IS 456:2000 Plain and Reinforced Concrete – Code of Practice
2.	N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.
3.	Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005.
4.	B.N Dutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2010
	E-resources
1.	https://www.economicus.org/library/harvard-chapter2-basic-real-estate-economics.pdf
2.	https://nptel.ac.in/courses/124107001

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Create** awareness about the job opportunities in the housing sector	**Cr**		
2.	**Comprehend** the building codes and make appropriate design decisions	**Un**		
3.	**Evaluate** the soil report effectively and choose appropriate foundation type	**An**		
4.	**Extract** the design data from the structural diagrams	**Ap**		
5.	**Prepare** the estimates of quantity and rate for a construction work	**Ap**		

Course delivery methods		**Assessment methods**	
1.	Self-paced learning	1.	Assessment (MCQ)
2.	Online/Physical expert sessions		

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Assessments –I,II,III	Learning score	Total Marks
Marks	MCQ – 20+20+50	10	100

Rubrics: Levels	**Target**
<40	Participation
41-70	Completion
71 - 100	First class

RENEWABLE ENERGY IN CIVIL ENGINEERING

Course Code		**Course type**	**Hybrid / One credit**
Hours/week: L - T- P	1-0-0		
Total Contact Hours	Self-paced learning/Hybrid – 15 hours		

Recommended Semester	**B.E/B.Tech – V,VI,VII,VIII**

Course learning objectives	
	This course aims to knowledge on the topics of
1.	Analyzing the global and Indian energy scenario and importance of renewable energy
2.	Acquiring knowledge on types of renewable energy and wind energy technologies
3.	Understanding fundamentals of solar energy and solar energy policies
4.	Recognizing the current and possible future role of solar energy systems
5.	Introducing the renewable energy technologies into civil engineering

Pre-requisites for the course	**NA**

Unit – I Introduction to Renewable Energy Sources	
Importance of renewable sources of energy, Sustainable Design and development, Types of resources, Limitations of renewable energy sources, Present Indian and international energy scenario of conventional and renewable energy sources, Indian Power Scenario, Carbon Pollution, Renewable energy transition from Fossil Fuel Energy, Renewable Energy Policies and Economics of Govt. of India.	

Unit – II Renewable Energy Types and Wind Energy Systems	
Various types of renewable energy, Solar Energy, Wind Energy, Biomass and Bioenergy Hydroelectric energy, Ocean Energy, Geothermal Energy. Wind data and energy estimation – Betz limit – Site selection for wind farms – characteristics – Wind resource assessment – Horizontal axis wind turbine – components – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems–Environmental issues and Applications.	

Unit – III Solar Energy Theory and Practice	
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage. Solar Energy policies of India, Solar power plant- Construction, Operation and maintenance of Solar power plant, OSOWOG Global Solar policies.	

Unit – IV Solar Energy Systems	
Solar Energy policies of India, Solar power plant- Construction, Operation and maintenance of Solar power plant, OSOWOG Global Solar policies, Battery Storage and Grid Integration, Solar based transportation system, Environmental, Social Governance of Solar power plant, Future Trends and Innovations in Solar Energy	

Unit – V Renewable Energy Into Civil Engineering	
Incorporating PV panels into building facades, roofs, or infrastructure elements- scale and location, small-scale or large-scale wind turbines in Buildings- Ground-Source Heat Pumps: heating and cooling for buildings, Renewable Energy Into Civil Engineering- Challenges and Design Limitations: Alterations to traditional design approaches.	

Books	
	Reference Books:
1.	Ankur Mathur, Non-Conventional Sources of Energy, Laxmi Publications Pvt. Ltd., 2015
2.	Ch. Pavan Kalyan and M. Pavan Das, Future Energy Scenario: A Better Planet with Renewable Energy, 2020
3.	Chapter 01 and 12, C. S. Solanki, Solar Photovoltaics – Fundamentals, Technologies and Applications, 3rd Ed. Prentice Hall of India, 2016
	E-resources
1.	https://nptel.ac.in/courses/103103206
2.	World Energy report https://www.iea.org/reports/world-energy-outlook-2021

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Create** awareness about renewable Energy Sources and technologies	**Cr**		
2.	**Interpret** the issues in harnessing renewable Energy	**Un**		
3.	**Evaluate** the current and possible future role of renewable energy sources	**An**		
4.	**Comprehend** the solar energy policies for construction of solar energy technologies	**Ap**		
5.	**Intergrate** the renewable energy systems in civil engineering structures	**Ap**		

Course delivery methods		Assessment methods	
1.	Self-paced learning	1.	Assessment (MCQ)
2.	Online/Physical expert sessions		

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Assessments –I,II,III	Learning score	Total Marks
Marks	MCQ – 20+20+50	10	100

Rubrics: Levels	**Target**
<40	Participation
41-70	Completion
71 - 100	First class

EMERGING TECHNOLOGY COURSES

CE23E01 ARTIFICIAL INTELLIGENCE FOR CIVIL ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction to Data Science (DS), Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL) – Information Theory – Concept of Learning –Context dependence – Interpretability – Complexity – Uncertainty – Scalability – Adaptability – Dynamism - Robustness and Resilience – Explainability – Recent advancements – Applications – Ethical and social considerations.

UNIT II MATHEMATICAL PRELIMINARIES AND PROGRAMMING 9

Problem formulation – Analytical Problem Solving – Probability and Statistical Concepts – Concept of Black Box – Data Modelling: Datasets and Features – Exploratory Data Analysis – Optimization – State Space – Search Space – Search Techniques – Classification and Regression Analysis – Basics of Neural Network – Programming Paradigms – Data Structures and Algorithms – Database Operations – Software: Modules and Packages for AI/ML/DL.

UNIT III ARTIFICIAL INTELLIGENCE 9

PEAS Concept – Types of Environments and Agents – AI Models – Search Methods and Strategies – Adversarial Search for Construction Project Network – Stochastic Games for Civil Engineering Decisions – Recommendation Systems for Concrete Technology and Soil Classifications, Computer Vision for Highway Engineering, GIS and Remote Sensing – Civil Engineering Case Studies.

UNIT IV MACHINE LEARNING 9

Machine translation – Types of Learning – Classification and Clustering Algorithms: Categorization – Regression Algorithms – Constraint Satisfaction – Feature Selection and Extraction – Decision Tree (DT) Induction – Types of DT – Predicting Strength of Concrete using DT, Classifying structural members based on performance and functionality – Natural Language Processing (NLP) – NLP for Questionnaire Design for Construction Managers – Performance Evaluation Metrics and ROC Curve – Civil Engineering Case Studies.

UNIT V DEEP LEARNING 9

Non-linear Models – Gradient Descent – Feedforward-Backpropagation Algorithms – Overfitting Problems – Regularization – Drop out technique – Prediction of Water Quality using Neural Network – Forecasting Weather using Artificial Neural Network (ANN) – Convolution Operation – Pooling Layer – Flattening – Convolution Neural Networks (CNNs) – Predicting failure of a structural element using CNN – Sequence Models: Recurrent Networks – Computer vision for flood monitoring and developing early warning strategies – Civil Engineering Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	**:**	To understand the concepts of Data Science (DS), Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL) and their characteristics.
CO2	**:**	To comprehend the knowledge on mathematical concepts and programming concepts related to the AI / ML / DL.
CO3	**:**	To understand the core concepts of AI and its applications to Civil Engineering domain such as Concrete Technology, Soil Mechanics, GIS and Remote Sensing.

CO4	**:**	To understand the core concepts of ML and its applications to Civil Engineering domain such as Structural Engineering.
CO5	**:**	To understand the core concepts of DL and its applications to Civil Engineering domain such as water quality modelling, and disaster mitigation planning and control.

TEXT BOOKS:

1. Russell, S and Norvig, P. Artificial Intelligence: A Modern Approach, 4th (Indian) Edition, Pearson, New Delhi, 2022.
2. Mitchell, T. M. Machine Learning, 1st (Indian) Edition, McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Ertel, W. Introduction to Artificial Intelligence, Second Edition, Springer Cham, 2017.
2. Bishop, C. M. Pattern Recognition and Machine Learning, First Edition, Springer Cham, 2016.
3. Unpingco, J. Python for Probability, Statistics, and Machine Learning, Third Edition, Springer, 2023.
4. Goodfellow, I.; Bengio, Y. and Courville, A. Deep Learning, MIT Press, USA, 2016.

CO-PO & PSO Mapping: ARTIFICIAL INTELLIGENCE FOR CIVIL ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	1	1	1	1	2	3	3	-	-	1	1	1	1
2	3	3	1	3	3	1	1	1	1	-	-	1	1	1	1
3	3	3	3	3	3	1	1	1	1	-	-	1	3	3	3
4	3	3	3	3	3	1	1	1	1	-	3	1	3	3	3
5	3	3	3	3	3	1	1	1	1	2	-	1	3	3	3
Avg.	3	3	2	3	3	1	1	1	1	1	1	1	2	2	2

‘1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23E02	UNMANNED AERIAL SYSTEM (UAS) FOR LARGE SCALE MAPPING	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Unmanned Aircraft Systems, History, Classification - Advantages - Aerodynamics and Airframe Configurations - Characteristics of Aircraft Types - Design Standards and Regulatory Aspects - Introduction to Design and Selection of the System for applications - Category of UAVs - Fixed wing - VTOL - Quadcopters – Nano, Mini, Micro – Small, Medium, Large – Launching and Landing methods -Hand - Catapult - Water surface - VTOL - civilian and military category classes.

UNIT II UAS HARDWARE AND CONTROL SYSTEMS 9

Components: Wings - Propellers - Sensors - Pitot tubes - Autopilot or manual operating system - IMU - UAS IP datalink - UAV tracking (antenna) - Mimo tracking antenna - Ground control systems - UAV gimbal - Propeller and accessories - Ground detecting sensors - Wing types and systems - Source of energy- Endurance – Range - Controls - PIO feedback - Modems - Memory system - Simulation - Ground test - Analysis – Troubleshooting, Anti-drone systems.

UNIT III PAYLOADS FOR UAS 9

Sensors: Payloads Dispensable Payloads - Non-Dispensable Payloads - Active Payloads - Passive Payloads –- Special sensors for UAV systems - Payloads: RGB, MSS, LiDAR, Microwave, Thermal, Hyperspectral, Magnetometer – Commercially available sensors: Specifications - Selection criteria of Payloads for various applications.

UNIT IV OPERATIONAL AND DATA PROCESSING SOFTWARE 9

Flight planning - Features of mission planning - Intuitive workflow - Polygon of AOI - Automatic 3D flight planning - Photogrammetry based flight simulation - Oblique and Ortho image coverage - Waypoints - Directional take-off - Real-time flight status – Preprocessing of data - Work flow of UAS photogrammetry - Camera model - Purpose of GCP - Point cloud and mesh – ray cloud DSM - Ortho– mosaic, DTM and other products – Commercial and Open source software.

UNIT V APPLICATIONS 9

Topographic mapping - Volume estimation from point cloud - Surveillance - Wildlife Monitoring – Disaster Management - Resource Applications: Forestry, Agriculture, Water, Archeology, Energy, Land, Glacier - Urban planning – Healthcare – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understanding the different types of UAS and their characteristics.
CO2: Synthesize the function of various components.
CO3: Know various payload available for mapping.
CO4: Plan and process UAS based mapping missions.
CO5: Plan and process UAS based mapping missions.

TEXT BOOKS:

1. Vahram Dilbaryan “Investigations about the use of UAV photogrammetry and Laser Scanning: Investigation about UAV Photogrammetry and Laser Scan for control of construction works by comparison with CAD model”, AV Akademikerverlag Publisher, 2017, ISBN: 978- 3639871098.
2. Lauren Newman , “Drones (21st Century Skills Innovation Library: Emerging Tech)”, Cherry Lake Publishing, 2017.
3. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010. ISBN: 978-0-470-05819-0.
4. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, 4th Edition, John Wiley

& Sons, Ltd, 2012. ISBN: 9781119978664.

REFERENCES:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001.
2. Kirnon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
3. Robert Nelson, “FLIGHT STABILITY AND AUTOMATIC CONTROL”, 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-0070661103.
4. https://www.pix4d.com/education-course-material**.**

CO-PO & PSO Mapping: UNMANNED AERIAL SYSTEM (UAS) FOR LARGE SCALE MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	1	2	3	3	-	-	1	1	1	1
2	3	3	1	3	3	1	1	1	1	-	1	1	1	1	1
3	3	3	3	3	3	1	1	1	1	1	-	1	3	3	3
4	3	3	3	3	3	1	1	1	1	-	3	1	3	3	3
5	3	3	3	3	3	1	1	1	1	2	-	1	3	3	3
Avg.	3	3	2	3	3	1	1	1	1	1	1	1	2	2	2

‘1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23E03	ROBOTICS IN CONSTRUCTION	L T P C 3 0 0 3

UNIT I INTRODUCTION 9

Introduction to Automation in Construction – Definition of Robots – Types of Robots – Specifications of Robots – Robot Manipulators – Robotics: Perception and Decision Making; Kinematics, Dynamics and Motion Control – Advantages of Robotics in Civil Engineering – Applications – Ethical and Social considerations.

UNIT II MATHEMATICAL MODELLING OF ROBOTS 9

Configuration Space – State Space – Actuator Space – Joint Space – Cartesian Space – Solvability – Standard Frames – Jacobians: Standard Forces and Velocities – Rigid and Non-rigid Bodies' Mechanics – Manipulator Dynamics: Lagrangian Formulation – Fundamentals of Data Structure for Robotics: Images, Translation, Rotation and Transformation, Calibration – Vision Algorithms – Object Recognition – Configurations – Software and Hardware Interfacing.

UNIT III ROBOTIC CONSTRUCTION 9

Basic Components and Terminologies – Joints and Links – Degree of Freedom – Motion Control Systems – DAQ Systems – Applications in Civil Engineering: Robotic Bricklaying and Plastering – Autonomous Excavation and Grading – Robotic Roofing and Installations – Robotics in Construction Supply Chain and Logistics – Robotics in Bridge Constructions – Robotic-IoT Integration for Offshore Operations and Tunnelling Operations – Robotics in Sustainability and Green Constructions – Civil Engineering Case Studies.

UNIT IV ROBOTIC INSPECTION, MONITORING AND DEMOLITION 9

Significance of Maintenance of Buildings – Sensing Devices – Actuators – Drones and Crawlers – Process for Developing Robot for Complex Civil Engineering Applications – Robotic Surveying and Mapping – Robotic Inspection and Monitoring of Civil Infrastructure Projects – Robotics in Real-time sensing of data from an Infrastructure Project leveraging for Artificial Intelligence (AI) applications – Robotic Site Clearance and Waste Management – Robotic Dismantling and Demolition – Civil Engineering Case Studies.

UNIT V 3D CONCRETE PRINTING 9

Digital Fabrication Process – Concept of Contour Crafting – History of 3D Concrete Printing – Types of 3D Concrete Printers – Methods of Concrete Extruction and Forming – Concrete Mix Design for 3D Concrete Printing – Problems and Challenges associated with 3D Concrete Printing Processes – Advantages of 3D Concrete Printing – Notable 3D Concrete Printed International Projects – 3D Printed Post-Office and other 3D Printed Projects in India – Recent advancements: 3D Concrete Printed Formworks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	**:**	To understand the fundamental concepts of robotics, types of robots and its applications.
CO2	**:**	To perceive the mathematical concepts and data structures applications related to robotics.
CO3	**:**	To understand the applications of robotics in the construction of civil infrastructure projects.
CO4	**:**	To understand the applications of robotics in the inspection, monitoring and demolition of civil infrastructure projects.
CO5	**:**	To comprehend the knowledge of 3D concrete printing and its significance in the construction projects.

TEXT BOOKS:

3. Craig, J. Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson, New Delhi, 2017.
4. Jebelli, H; Habibnezhad, M; Shayesteh, S; Asadi, S. and Lee, S. (Editors). Automation and Robotics in the Architecture, Engineering, and Construction Industry, Springer, Switzerland, 2022.

REFERENCES:

5. Bock, T. and Linner, T. Construction Robots: Volume 3 - Elementary Technologies and Single-Task Construction Robots, Cambridge University Press, 2016.
6. Mason, M.T. Mechanics of Robotic Manipulation (Intelligent Robotics and Autonomous Agents), Bradford Books, 2001.
7. Siciliano, B; Sciavicco, L; Villani, L. and Oriolo, G. Robotics Modelling, Planning and Control, Springer, London, 2009.
8. Warszawski, A. Industrialized and Automated Building Systems: A Managerial Approach, 2nd Edition, Routledge, UK, 2003.

CO-PO & PSO Mapping: ROBOTICS IN CONSTRUCTION

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	2	1	1	1	1	3	3	1	1	1	1	1	1
2	3	3	1	2	1	1	1	1	1	2	1	3	1	1	1
3	3	3	3	3	2	1	2	3	1	3	2	1	3	3	3
4	3	3	3	3	2	1	1	3	1	2	2	1	3	3	3
5	3	3	3	3	2	1	1	3	1	2	2	1	3	3	3
Avg.	3	3	2	2	2	1	1	3	1	2	2	1	2	2	2

'1' = Low; '2' = Medium; '3' = High

MINOR PROGRAMME ON CONSTRUCTION ENGINEERING
Offered by Department of Civil Engineering for other Branch students

CE23044 CONSTRUCTION ENGINEERING PRACTICES L T P C
3 0 0 3

UNIT I STONES AND BRICKS 9
Stone as building material - Criteria for selection - Tests on stones - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive strength - Water Absorption - Efflorescence - Application.

UNIT II LIME, CEMENT AND CONCRETE 9
Lime - Uses - Preparation of lime mortar - Cement - Ingredients - Mechanism of hydration - Cement mortar - Test on cement - Aggregates - Fine and coarse aggregates - Test on aggregates - Ingredients for concrete - Water cement ratio - Concrete blocks.

UNIT III OTHER MATERIALS 9
Timber - Market forms - Plywood - Veneer - False ceiling materials - Laminates - Steel - Mechanical treatment - Aluminium - Uses - Market forms - Glass - Refractories - Composite Materials - FRP - Geo textiles - Floor finishing materials - Bitumen.

UNIT IV CONSTRUCTION PRACTICES 9
Stone masonry - Brick masonry - Cavity walls - Flooring - Formwork - Centering and shuttering - Sheet piles - Slip and moving forms - Roofs and roof covering - Plastering and pointing - Shoring - Scaffolding.

UNIT V SERVICE REQUIREMENTS 9
Painting, distempering and white washing - Surface preparation and defects in painting and distempering and white washing - Fire Protection - Thermal insulation - Ventilation and air conditioning - Acoustics and sound insulation - Damp proofing - Termite proofing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the student is expected to be able to:

CO1 Identify the good qualities of stones and bricks for construction
CO2 Have thorough knowledge on lime, cement and their products
CO3 Recognize the market forms of other construction materials such as timber, plywood, steel, aluminium etc.
CO4 Explore the various construction practices and practical importance
CO5 Impart knowledge on appropriate service requirements

TEXTBOOKS:
1. Varghese P. C., “Building Construction”, Second Edition, PHI Learning Ltd., 2016.
2. Gambhir and Neha Jamwal, “Building and Construction Materials”, Second Edition, McGraw Hill Education Pvt. Ltd., 2015.

REFERENCES:
1. Arora S. P. and Bindra S. P., “Building Construction”, Dhanpat Rai and Sons,1997.
2. Punmia B. C., “Building Construction”, Laxmi Publication (p) Ltd., 2008.
3. Neville A. M., “Properties of Concrete”, Fourth Edition, Pearson Education Ltd, 2012.

CO-PO & PSO MAPPING: CONSTRUCTION ENGINEERING PRACTICES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	2	2	3	2	2	3	2	3	3	2	2	2	2
2	3	2	3	3	3	3	2	3	2	3	3	3	3	2	2
3	2	3	2	2	2	2	3	2	2	3	3	3	3	2	2
4	3	2	3	3	3	2	2	3	3	2	2	3	2	2	3
5	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23045 SURVEYING TECHNIQUES L T P C
3 0 0 3

UNIT I FUNDAMENTALS AND CONVENTIONAL SURVEYING 9

Definition - Classifications - Basic principles - Equipment and accessories for ranging and chaining - Methods of ranging - Well conditioned triangles - Chain traversing - Compass - Basic principles - Types - Bearing - System and conversions - Sources of errors and local attraction - Magnetic declination - Dip - Compass traversing - Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection - Plane table traversing- Maps: Types- Scale- Co-ordinate system.

UNIT II LEVELLING 9

Level line - Horizontal line - Datum - Benchmarks - Levels and staves - Temporary and permanent adjustments - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Precise levelling - Contouring - Methods of interpolating contours - Characteristics and uses of contours - Areas enclosed by straight lines - Irregular figures - Volumes - Earthwork calculations.

UNIT III THEODOLITE SURVEYING 9

Theodolite - Types - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Trigonometric levelling - Heights and distances - Single plane method - Double plane method - Geodetic observation - Tacheometric surveying - Stadia tacheometry - Subtense method - Tangential tacheometry- Curves: Horizontal, Vertical- Setting out of curves.

UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and vertical control - Methods - Triangulation - Baseline - Instruments and accessories - Corrections - Satellite station - Traversing - Coordinate computation - Gale‘s table - Omitted measurement - Trilateration - Concepts of measurements and errors - The weight of an observation - Law of weight - Adjustment methods - Angles, lengths and levelling network - Simple problems.

UNIT V MODERN SURVEYING 9

Total station: Digital theodolite, EDM, electronic field book - Advantages - Parts and accessories - Working principle - Observables - Errors - COGO functions - Field procedure and applications - GPS: Advantages - System components - Signal structure - Selective availability and antispoofing receiver components and antenna - Planning and data acquisition - Data processing - Errors in GPS - Field procedure and applications- Basis of Photogrammetry and Remote Sensing- Scale, Resolution.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Gain a solid understanding of the fundamental principles and concepts of surveying, including measurements, coordinate systems, accuracy, error analysis, and surveying instruments
CO2 Plan and conduct field surveys effectively
CO3 Conduct surveys to accurately measure and map the features, contours, and elevations of a given area of land using appropriate surveying techniques and equipment
CO4 Analyse survey data using appropriate mathematical and statistical techniques, interpret the results, and generate accurate reports, drawings, and maps based on the collected data
CO5 Imparts the knowledge of modern surveying instruments

TEXT BOOKS:

1. T. P. Kanetkar and S. V. Kulkarni, “Surveying and Levelling”, Part 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th edition, 2010, ISBN-10: 8185825114, ISBN-13: 978-8185825113.
2. Dr B. C. Punmia, Ashok K. Jain and Arun K Jain, “Surveying Vol. I & II”, Lakshmi Publications Pvt Ltd, New Delhi, 16th edition, 2016, ISBN-10: 9788170088530, ISBN-13:978-8170088530.

REFERENCES:

1. R. Subramanian, “Surveying and Levelling”, Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13: 978-0198085423.
2. James M. Anderson and Edward M. Mikhail, “Surveying, Theory and Practice”, McGraw Hill, 7th edition, 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. Bannister and S. Raymond, “Surveying”, Longman, 7th edition, 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.
4. S. K. Roy, “Fundamentals of Surveying”, Prentice Hall of India, 2nd edition, 2004, ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K. R. Arora, “Surveying Vol I & II”, Standard Book House, 2019, ISBN-13: 9788189401238.
6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, 2nd edition, 2011, ISBN-10: 9788173717406, ISBN-13: 978-8173717406.
7. Günter Seeber, “Satellite Geodesy”, Walter de Gruyter, Berlin, 2nd revised and extended edition, 2003.

CO-PO & PSO MAPPING: SURVEYING TECHNIQUES

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	3	1	2	3	2	1	2	3	3	3
2	3	3	3	3	2	3	2	2	3	1	1	2	3	3	3
3	3	3	3	2	3	3	2	2	3	1	1	3	3	3	3
4	3	2	3	3	3	3	1	2	3	2	1	3	3	3	3
5	3	3	3	3	3	3	2	1	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

- 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23046 GEOTECHNICAL ENGINEERING L T P C
3 0 0 3

UNIT I SOIL FORMATION AND COMPACTION 9

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

UNIT II ENGINEERING PROPERTIES OF SOILS 9

Soil water – Effective stress concepts in soils – Permeability – Darcy's law – Laboratory determination of permeability – Stress distribution in soil - Terzaghi's one dimensional consolidation theory – Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength parameters.

UNIT III BEARING CAPACITY OF SHALLOW FOUNDATIONS 9

Site Investigation – Scope and objectives – Methods of exploration – Types of Isolated footing, combined footing, mat foundation - Location and depth of foundation – Bearing capacity of shallow foundation – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Settlement and its minimization.

UNIT IV PILE FOUNDATIONS 9

Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Negative skin friction – Uplift capacity – Group capacity by different methods (Feld's rule and block failure criterion) – Settlement of pile groups – Pile load test (routine test only) – Under reamed piles.

UNIT V SLOPE STABILITY AND LATERAL EARTH PRESSURE 9

Stability Analysis – Infinite and finite slopes – Total stress, method of slices, Taylor's stability number – Slope protection measures – Earth Pressure – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Stability analysisof retaining walls

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Classify soils based on their index properties
CO2	Assess the engineering properties of soils
CO3	Plan and design shallow foundations
CO4	Select and design pile foundations based on soil condition
CO5	Analyse stability of slopes and retaining walls

TEXTBOOKS:

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, 2018

REFERENCES:

1. Das, B.M., "Principles of Geotechnical Engineering". Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.

2. McCarthy, D.F., “Essentials of Soil Mechanics and Foundations”. Prentice-Hall, 2006. 2. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3. Das, B.M. “Principles of Foundation Engineering” (Eigth edition), Thompson Asia Pvt. Ltd., Singapore, 2013.
4. Kaniraj, S.R. “Design aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
5. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005.

COs- PO’s & PSO’s MAPPING: GEOTECHNICAL ENGINEERING

	PO’s												PSO’s		
CO’s	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	2	2	3	2	1	1	1	1	2	3	3	3	2
2	3	3	3	2	2	2	1	1	1	1	2	3	2	2	3
3	3	3	3	2	2	2	1	1	1	1	2	3	2	2	3
4	3	3	3	3	1	1	1	1	1	1	2	3	2	3	3
5	3	3	3	3	2	1	1	2	1	1	2	3	2	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23047 TRANSPORTATION ENGINEERING L T P C
3 0 0 3

UNIT-I HIGHWAY ENGINEERING 9

Institutions for Highway planning- Classification of highways- Typical cross sections of Urban and Rural roads- factors influencing highway alignment- Engineering surveys for alignment- Conventional and Modern method.

UNIT-II DESIGN OF HIGHWAY ELEMENTS 9

Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients– pavement types, components and their role.

UNIT III RAILWAY ENGINEERING 9

Permanent way - Gauges - Components - Functions and requirements - Geometric design- Urban Rail Transit Planning – MRTS – LRTS, Metro Rail – Monorail.

UNIT IV AIRPORT ENGINEERING 9

Aircraft characteristics - -airport classification- airport site selection- typical Airport Layouts, Airport obstructions and zoning - Runway - Orientation of Runways and correction factors as ICAO stipulations, taxiways and aprons- Terminal area planning

UNIT V HARBOUR ENGINEERING 9

Docks and Harbours - Types - Layout and planning principles- breakwaters – docks wharves and quays - Transit sheds- warehouses- navigation aids.

TOTAL HOURS- 45

OUTCOMES:

Students will be able to

- Plan a highway according to the principles and standards adopted in various intuitions in India.
- Design the geometric features of road network and understand the components of pavement.
- Understand the concepts of permanent way, geometric design and Urban Rail Transit Planning
- Understand the concepts and elements in airport planning, and airport layout.
- Understand the terminologies, infrastructures in Harbour Engineering

TEXTBOOKS:

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2017.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai,2010
3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 6th edition Delhi,2015.
4. C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.

REFERENCES:

1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC:37-2012
2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC:58-2012
3. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia,2012
4. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, Ist Edition, USA,2011
5. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi,2011

6. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi,2010
7. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998.
8. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand andBros, Roorkee, 1994.
9. Oza and Oza, Elements of Dock and Harbour Engineering, Charotar Publishing House, 1996.

CO-PO & PSO MAPPING: TRANSPORTATION ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	2	2	3	3	3	2	2	2	2	3	3	3	3
2	3	2	3	2	3	2	3	2	2	2	2	3	3	2	2
3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
4	2	3	3	2	2	2	2	2	2	2	2	3	3	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23048 WATER AND WASTEWATER ENGINEERING L T P C
3 0 0 3

UNIT I WATER SUPPLY 9

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

UNIT II WATER TREATMENT 9

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

UNIT III WATER STORAGE AND DISTRIBUTION 9

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

UNIT IV PLANNING AND DESIGN OF SEWERAGE SYSTEM 9

Characteristics and composition of sewage - Population equivalent - Sanitary sewage flow estimation- Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Storm drainage-Storm runoff estimation - Sewer appurtenances - Corrosion in sewers - Prevention and control – Sewage pumping-drainage in buildings - Plumbing systems for drainage

UNIT V SEWAGE TREATMENT AND DISPOSAL 9

Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended aeration systems - Trickling filters - Sequencing Batch Reactor(SBR) - UASB - Waste Stabilization Ponds - Other treatment methods - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance aspects. - Discharge standards-sludge treatment -Disposal of sludge

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

CO1 Understand the various components of water supply scheme and design of intake structure and conveyance system for water transmission

CO2 Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations

CO3 Understand the process of conventional treatment and design of water and wastewater treatment system and gain knowledge for sele ction of treatment process and biological treatment process

CO4 Ability to design and evaluate water distribution system and water supply in buildings and understand the self-purification of streams and sludge and septage disposal methods.

CO5 Able to understand and design the various advanced treatment system m and knowledge about the recent advances in water and wastewater treatment process and reuse of sewage

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2016.
3. Garg, S.K., Environmental Engineering Vol.II, Khanna Publishers, New Delhi, 2015.
4. Duggal K.N., “Elements of Environmental Engineering” S. Chand and Co. Ltd., New Delhi, 2014.

5. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

REFERENCES:

1. Punmia B.C, Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi 2010.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Syed R. Qasimand Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.
4. Metcalf and Eddy – Waste water Engineering – Treatment and Reuse, Tata Mc. Graw – Hill Company, New Delhi, 2010.
5. Syed R.Qasim "Waste water Treatment Plants", CRCPress,WashingtonD.C.,2010
6. Gray N.F, "Water Technology", Elsevier India Pvt.Ltd. New Delhi, 2006.

COs- PO's & PSO's MAPPING: WATER AND WASTEWATER ENGINEERING

	PO's												PSO's		
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	2	1	2	2	2	2	2	3
2	3	3	1	2	2	3	2	1	2	2	1	1	3	1	1
3	2	3	2	3	-	1	1	2	2	2	2	2	1	2	2
4	2	2	1	2	2	2	2	1	1	3	3	2	2	1	3
5	2	2	2	2	2	1	3	3	3	1	2	2	1	1	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1' = Low; '2' = Medium; '3' = High

CE23049 ESTIMATION, COSTING AND VALUATION L T P C
3 0 0 3

UNIT I QUANTITY ESTIMATION 9

Methods of estimation - Types of estimates - Approximate estimates - Detailed estimate - Estimation of quantities for buildings, roads, canals and hydraulic structures.

UNIT II RATE ANALYSIS AND COSTING 9

Standard data - Observed data - Schedule of rates - Market rates - Assessment of man hours and machineries for common civil works - Rate analysis.

UNIT III SPECIFICATIONS, REPORTS AND TENDERS 9

Specifications - Constructions - Sources - Types Principles for report preparation - Report on estimate of residential building - Culvert - Roads - TTT Act 2023 - Tender notices - Tender procedures - Drafting model tenders, E-tendering - Digital signature certificates - Encrypting - Decrypting - Reverse auctions.

UNIT IV CONTRACTS 9

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

UNIT V VALUATION 9

Definitions - Various types of valuations - Valuation methods - Valuation of land - Buildings - Valuation of plant and machineries - Calculation of standard rent - Mortgage - Lease.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual and software packages
CO2 Acquire the knowledge to calculate rate analysis and man-hours required for the common civil works by manual and software packages
CO3 Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation and report preparation
CO4 Acquire the knowledge of construction contracts and contract document preparation
CO5 Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease

TEXTBOOKS:

1. B. N. Dutta, “Estimating and Costing in Civil Engineering”, CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B. S. Patil, “Civil Engineering Contracts and Estimates”, 7th edition, University Press, 2015.
3. D. N. Banerjee, “Principles and Practices of Valuation”, V Edition, Eastern Law House, 2015.

REFERENCES:

1. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

CO-PO & PSO MAPPING: ESTIMATION, COSTING AND VALUATION

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
3	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
4	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

MINORS ON ENVIRONMENTAL ENGINEERING

Offered by Department of Civil Engineering for other Branch students

CE23901 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY L T P C
3 0 0 3

UNIT I ENVIRONMENTAL AQUATIC CHEMISTRY 9

Stoichiometry and mass balance-chemical equilibria, acid base, solubility product(Ksp), chemical kinetics, fate of chemicals and typical pollutants in aquatic environment -characteristics of water pollution, volatilization, coagulation, partitioning, hydrolysis, photochemical transformation– Degradation of pesticides and surfactants - Metals, complex formation, oxidation and reduction.

UNIT II ATMOSPHERIC AND ENVIRONMENTAL SOIL CHEMISTRY 9

Atmospheric structure – major air pollutants – oxides of carbon, nitrogen, sulphur – Hydrocarbons - chemical and photochemical reactions - Ozone layer depletion – greenhouse gases and global warming, Acid rain- origin and composition of particulates, evolution of soil chemistry- contaminants in soil – inorganic soil components- primary soil minerals, secondary soil minerals, nature and composition of soil-clays- ion-exchange reactions in soil – agricultural chemicals in soil, Heavy Metals- Chemical speciation and their toxicity

UNIT III CLASSIFICATION AND CHARACTERISTICS OF MICROORGANISMS `9

Classification and distribution of microorganisms – aerobic and anaerobic cultures, synchronous and asynchronous culture, batch, fed batch and continuous culture, measurement of growth, factors affecting growth, Microbial interactions - biogeochemical cycles – Nutrition - Respiration, aerobic and anaerobic-fermentation.

UNIT IV MICROORGANISMS IN THE ENVIRONMENT 9

Transmission of pathogens - soil, water, air – Indicator organisms - Total coliforms, *E. coli*, streptococcus, clostridium - Detection of virus - toxicity testing, - bioconcentration – bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching.

UNIT V APPLICATIONS OF MICROORGANISMS FOR CLEAN ENVIRONMENT 9

Microbial assessment of water quality, microbes as bio-indicators - treatment of municipal water, solid and liquid based treatment, biological (aerobic, anaerobic, primary, secondary & tertiary) treatment - Nutrients removal – BOD, nitrogen, phosphate, nitrification and denitrification, eutrophication – causes and effects – Role of microorganisms in remediation of contaminated soils.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Explain the various chemical pollutants present in aquatic environment, their sources, characteristics, and the chemical reactions involved
CO2	Demonstrate knowledge and understanding of various soil and atmospheric chemical environment arise in nature, apply the knowledge to explain the real-world environmental chemistry. Capable of using theoretical knowledge to solve real-world type problems
CO3	Gain knowledge on the distribution of various microorganisms in different ecosystems, the factors affecting the growth of the organisms, the significance of the organisms in organic matter decomposition and environmental clean up
CO4	Select appropriate techniques to enumerate the pathogens in wastewater, exploitation of microorganisms to indicate the various pollutants in water and design experiments to remove the pollutants from wastewater using microorganisms
CO5	Apply the knowledge to design appropriate methods or experiments to treat the wastewater to remove the nutrients by utilizing the suitable microorganisms, their nutrient requirement and the metabolic pathway

REFERENCES:

1. Chemistry for Environmental Engineering and Science, Sawyer,C.N., MacCarty, P.L. and Parkin, G.F Tata McGraw – Hill, Fifth edition, New Delhi (2003).
2. Environmental Chemistry', Freeman and company, New York, (2012).
3. Environmental Chemistry, Eighth Edition, Colin Baird and Michael Cann Manahan, S.E., CRC press (2005)
4. P.K. Goel, Water Pollution: Causes, Effects and Control, New Age International, NewDelhi, 2006
5. Hand Book of Environmental Microbiology, S.C.Bhatia, Vol 1, 2 and 3, Atlantic Publisher,2008.
6. Text Book of Environmental Microbiology, Pradipa K. Mohapatra, I.K. International Publishing House pvt. Ltd., 2008
7. A Text Book of Microbiology, R.C. Dubey and D. K. Maheswari S. Chand & Company Ltd - New Delhi, 2013
8. Environmental Microbiology: Fundamentals and Applications Bertrand, J.-C., Caumette, P., Lebaron, P., Matheron, R., Normand, P., Sime-Ngando, T. (Eds.) Springer, 2015

CO-PO-PSO MAPPING: ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	2	1	2	2	2	2	2	3
2	3	3	1	2	2	3	2	1	2	2	1	1	3	1	1
3	2	3	2	3	-	1	1	2	2	2	2	2	1	2	2
4	2	2	1	2	2	2	2	1	1	3	3	2	2	1	3
5	2	2	2	2	2	1	3	3	3	1	2	2	1	1	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2

• 1' = Low; '2' = Medium; '3' = High

CE23902 ENVIRONMENTAL ECONOMICS L T P C
3 0 0 3

UNIT I PRINCIPLES OF ECONOMICS 9

Environment as an Asset - Interaction between economy and environment – Economic concepts of Wealth, Welfare, Scarcity, Growth, Sustainability, Costs, Benefits, Opportunity costs ,Social Costs- Trade off and marginal thinking- Marginal Costs and Marginal Benefits – Positive and Normative criteria for decision making - Equi marginal principle- Abatement cost and Efficient level of pollution - Marginal Damage Functions –Consumer Choice theory – Economic Efficiency and Markets– Supply and Demand– Consumers' surplus - Producers' surplus and net social benefit -Static and dynamic efficiency - market failures –Property Rights, Externalities, and Environmental Problem - Coase Theorem - Public Goods and Externalities - Free rider problem – Tragedy of the commons

UNIT II ECONOMIC VALUATION OF ENVIRONMENTAL RESOURCES 9

Types of Economic value - Environmental Benefits and Environmental Costs – Classifying economic valuation methods– Direct and indirect methods – Surrogate markets – Stated Preference and Revealed Preference methods- hedonic prices, travel cost models, contingent valuation, benefit transfer – economic valuation of ecosystem services- Assessment of Loss of Ecology - Valuation of Health impacts - Environmental accounting

UNITIII ECONOMICS OF POLLUTION PREVENTION AND CONTROL 9

Economics of Environmental Quality- - Cost benefit analysis and Cost effectiveness analysis– welfare foundation of cost-benefit analysis - Principles, methodology and Limitations – Discounting and intergenerational equity - Profitability of Pollution Prevention - Pay back period – Present value estimation – Internal rate of return –Economic analysis of Pollution Prevention Case studies– economically efficient pollution control programmes – Economics of Enforcement - Efficient allocation of pollution from mobile and stationery source – Total Cost Assessment- Life cycle costing-Green Accounting and Economic indicators

UNIT IV ECONOMIC INSTRUMENTS FOR ENVIIRONMENTAL PROTECTION 9

Economic analysis of Environmental Policy -Regulatory versus Economic Instruments – Decentralized Policies: Liability Laws, Property Rights, and Moral Suasion - Command-and- Control Strategies - Pigovian and Pollution Taxes – Internalizing externality using the Pigouvian tax approach - Emission Charges and Subsidies– Marketable permits – Emission trading –– Non Compliance fees, bonds and deposit refunds –Evaluation of Instruments – Choice of instruments for Environmental policy - macroeconomic effects of environmental regulations - - Economics of Climate Change – Climate Finance – Carbon credits.

UNIT V NATURAL RESOURCE ECONOMICS 9

Natural Resources and Environmental resources – Concept and Classification , Scarcity and its economic implications - Economics of depletable and non-renewable resources – Recyclable resources – Replenishable but depletable resources – Storable renewable resources – Renewable common property Resources–Optimal Use of Exhaustible Resources-Natural resources accounting - Economics of Forestry and fisheries exploitation –Trade and environment – Income Effects and

Environmental Kuznets Curves – Race to the Bottom and Pollution Haven Hypothesis - Porter Hypothesis

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 explain the various terms and basic principles of environmental economics

CO2 apply the knowledge of science and engineering fundamentals to analyse costs, benefits and value of environmental and natural resources accounting

CO3 design of economic instruments and policies for optimal pollution, economics of exhaustible resources and renewable resources

CO4 select appropriate economic instruments and policies for environmental management taking into account the impact of the solutions in a sustainability context

CO5 conduct research pertinent to environmental economics and communicate effectively to different stakeholders as well as engage in independent life- long learning

REFERENCES:

1. Tom Tietenberg, Lynne Lewis ,Environmental Economics: The Essentials, Taylor & Francis, 2019
2. Tom Tietenberg, Lynne Lewis , Natural Resource Economics: The Essentials, Taylor & Francis, 2019
3. Barry Field and Martha Field, Environmental Economics: An Introduction, McGraw-Hill, 2021.
4. Nancy Olewiler; Barry Field, Environmental Economics , McGraw-Hill Ryerson, 2015
5. Kate Raworth, Doughnut Economics - Seven ways to think like a 21st century Economist, Random House Business Books, UK, 2017
6. Kolstad, Charles, Environmental Economics", Oxford University Press, New York, 2011
7. John Asafu Adjaye, " Environmental Economics for non-Economists – techniques and policies for Sustainable Development, World Scientific,2005

CO-PO-PSO MAPPING: ENVIRONMENTAL ECONOMICS

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	1	2	2	2	1	2	2	2	2	2	3

2	1	3	2	3	2	3	2	1	2	2	2	1	3	1	1
3	2	3	2	3	1	2	1	2	2	2	2	2	1	2	2
4	1	2	2	2	2	2	2	2	1	3	3	2	2	2	3
5	2	2	2	2	2	1	2	3	2	2	2	2	2	1	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23903 WATER AND WASTEWATER ENGINEERING L T P C
3 0 0 3

UNIT I WATER SUPPLY 9

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

UNIT II WATER TREATMENT 9

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

UNIT III WATER STORAGE AND DISTRIBUTION 9

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

UNIT IV PLANNING AND DESIGN OF SEWERAGE SYSTEM 9

Characteristics and composition of sewage - Population equivalent - Sanitary sewage flow estimation- Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Storm drainage-Storm runoff estimation - Sewer appurtenances - Corrosion in sewers - Prevention and control – Sewage pumping-drainage in buildings - Plumbing systems for drainage

UNIT V SEWAGE TREATMENT AND DISPOSAL 9

Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended aeration systems - Trickling filters - Sequencing Batch Reactor(SBR) - UASB - Waste Stabilization Ponds - Other treatment methods - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance aspects. - Discharge standards-sludge treatment -Disposal of sludge

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Characterize the quality of surface and sub-surface water.
CO2	Understand the various unit operations and processes pertaining to conventional water treatment and gain knowledge for selction of treatment scheme.
CO3	Ability to design and evaluate water distribution system and water supply in buildings
CO4	Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations
CO5	Able to understand and design the various conventional sewage treatment systems and knowledge about the recent advances in sewage treatment processes and reuse of sewage.

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2016.
3. Garg, S.K., Environmental Engineering Vol.II, Khanna Publishers, New Delhi, 2015.
4. Duggal K.N., "Elements of Environmental Engineering" S. Chand and Co. Ltd., New Delhi, 2014.
5. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

REFERENCES:

1. Punmia B.C, Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi 2010.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Syed R. Qasimand Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.
4. Metcalf and Eddy – Waste water Engineering – Treatment and Reuse, Tata Mc. Graw – Hill Company, New Delhi, 2010.
5. Syed R.Qasim "Waste water Treatment Plants", CRC Press,Washington D.C.,2010
6. Gray N.F, "Water Technology", Elsevier India Pvt.Ltd. New Delhi, 2006.

CO-PO-PSO MAPPING: WATER AND WASTEWATER ENGINEERING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	2	1	2	2	2	2	2	3
2	3	3	1	2	2	3	2	1	2	2	1	1	3	1	1
3	2	3	2	3	-	1	1	2	2	2	2	2	1	2	2
4	2	2	1	2	2	2	2	1	1	3	3	2	2	1	3
5	2	2	2	2	2	1	3	3	3	1	2	2	1	1	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1' = Low; '2' = Medium; '3' = High

CE23904 ENVIRONMENTAL IMPACT ASSESSMENT L T P C
3 0 0 3

UNIT I ENVIRONMENTAL CLEARENCE 9

Sustainable Development-Environmental Clearance- EIA Notification- screening – scoping - terms of reference in EIA- setting – analysis – mitigation–public hearing in EIA- Schedule-EIA consultant accreditation.

UNIT II STAGES OF EIA 9

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-Rehabilitation and Resettlement

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings

UNIT V EIA-CASE STUDIES 9

Case Studies of EIA for Thermal Power Plants, Mining Projects, Highways-Airports-Ports and Harbours-Distilleries-Cement Industries-CETPs-Solid Waste Management facilities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
CO2	Understand various stages of conducting EIA study
CO3	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
CO4	Prepare environmental management and monitoring plan
CO5	Understand conduct and prepare the reports based on case studies

REFERENCES:

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey

CO-PO-PSO MAPPING: ENVIRONMENTAL IMPACT ASSESSMENT

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	2	1	2	2	2	1	2	2	2	2	2	3
2	1	3	3	3	2	3	2	1	2	2	2	2	3	1	1
3	2	2	2	2	1	2	1	2	2	2	2	2	2	2	2
4	2	2	2	2	2	1	3	2	2	3	2	2	2	2	2
5	2	2	2	2	2	1	2	2	2	3	2	2	2	2	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23905 AIR AND NOISE POLLUTION CONTROL L T P C
3 0 0 3

UNIT I AIR POLLUTION-SOURCE AND EFFECTS 9

Structure and composition of Atmosphere – Sources and classification of air pollutants – Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects– Ambient Air Quality and Emission Standards

UNIT II AIR SAMPLING AND ANALYSIS 9

Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants -Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants

UNIT III CONTROL OF PARTICULATE POLLUTANTS 9

Factors affecting Selection of Control Equipment; – Working principle, Design and performance equations of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators

UNIT IV CONTROL OF GASEOUS POLLUTANTS 9

Factors affecting Selection of Control Equipment -Working principle, Design and performance equations of Absorption, Adsorption, Condensation, Incineration, Control Technologies-SO_2,NO_x

UNIT V NOISE POLLUTION 9

Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Equivalent Noise Level-Ambient and Source, Noise Standards - Sampling of ambient and -Statistical Analysis of Noise Control and Preventive measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Understand the various types and sources of air pollution and its effects
CO2	Demonstrate the stack and ambient air sampling.
CO3	Design of control equipment for particulate pollutants.
CO4	Design of control equipment for Gaseous emissions.
CO5	Understand sources, effects and control of noise pollution

REFERENCES:

1. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016.
2. Arthur C.Stern, “Air Pollution (Vol.I – Vol.VIII)”, Academic Press, 2006.
3. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
4. David H.F. Liu, Bela G. Liptak, “Air Pollution”, Lweis Publishers, 2000.

5. Wayne T.Davis, “Air Pollution Engineering Manual”, John Wiley & Sons, Inc., 2000.
6. Central Pollution Control Board, Guidelines for real time sampling and analysis ,2013.

CO-PO-PSO MAPPING: AIR AND NOISE POLLUTION CONTROL

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	2	1	2	2	2	1	2	2	2	2	2	3
2	1	3	2	3	2	3	2	1	2	2	2	1	3	1	1
3	2	3	2	3	1	2	1	2	2	2	2	2	1	2	2
4	1	2	2	2	2	2	2	2	1	3	3	2	2	2	3
5	2	2	2	2	2	1	2	3	2	2	2	2	2	1	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

CE23906 WASTE MANAGEMENT FOR CIRCULAR ECONOMY L T P C
3 0 0 3

UNIT I INTRODUCTION TO WASTE CLASSIFICATION & CIRCULAR ECONOMY 10

Sources and types of wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects — solid waste (M&H) rules — Integrated solid waste management-Public awareness; Role of NGO's- Public Private participation- Introduction to circular economy-Purpose of circular economy-Circular sustainability- Challenges for circular economy.

UNIT II ON-SITE STORAGE AND PROCESSING 8

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and environmental aspects of open storage – waste segregation and storage - case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling of plastic waste –Construction and Demolishing waste.

UNIT III COLLECTION AND TRANSFER 9

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes - Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems - case studies on waste collection and material recovery-Circular bioeconomy- Circular Business Models to create economic and social value-Extended Producer Responsibility

UNIT IV OFF-SITE PROCESSING 9

Objectives of waste processing — Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options — case studies under Indian conditions.

UNIT V DISPOSAL 9

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite capping –Biomining – Case studies on Biomining

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1	Understand the nature and characteristics of municipal solid wastes and theregulatory requirements regarding municipal solid waste management
CO2	Explains the segregation of solid waste and the onsite storage methods
CO3	Explains the various transfer methods and to know the site condition for thetransfer station
CO4	Select appropriate methods for processing and disposal of solid and hazardouswastes, taking into account the impact of the solutions in a sustainability context
CO5	Knowledge about selection of appropriate disposal methods and its handling in anefficient manner

TEXTBOOKS

1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018
2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management — Science and Engineering , Butterworth-Heinemann, 2016

REFERENCES:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, "Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.
6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010

CO-PO-PSO MAPPING: WASTE MANAGEMENT FOR CIRCULAR ECONOMY

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	2	1	2	2	2	1	2	2	2	2	2	3
2	1	3	3	3	2	3	2	1	2	2	2	2	3	1	1
3	2	2	2	2	1	2	1	2	2	2	2	2	2	2	2
4	2	2	2	2	2	1	3	2	2	3	2	2	2	2	2
5	2	2	2	2	2	1	2	2	2	3	2	2	2	2	1
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

• 1' = Low; '2' = Medium; '3' = High