B.E. (Civil Engineering)

2022 Regulations, Curriculum & Syllabi

(For 2022-26 & 2023-27 Batches)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA

Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : stayahead@bitsathy.ac.in Web : www.bitsathy.ac.in

CONTENTS

VISION OF THE DEPARTMENT

To educate the students to face the challenges pertaining to Civil Engineering by maintaining continuous sprit on creativity, innovation, safety and ethics.

MISSION OF THE DEPARTMENT

i. To prepare students to learn beyond the syllabi and textbooks.

ii. To train students through periodical in-plant training and industrial visits.

iii. To motivate students to pursue higher education through competitive examinations.

iv. To create Centre of Excellence in the emerging areas of Civil Engineering.

v. To give a broad education to the students on recent areas of development through interactions and camps.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To demonstrate technical competency in their chosen career path of academics, research, public service or entrepreneurial start-up.

II. To execute planning, design and analysis of Civil Engineering systems catering to the societal and industrial needs with academic or research perspective adapting to the sustainable development goals.

III. To exhibit leadership qualities in their intellectual pursuit upholding professionalism, ethics and sustainability.

PROGRAMME OUTCOMES (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, andthe cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects andin multidisciplinary environments.

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

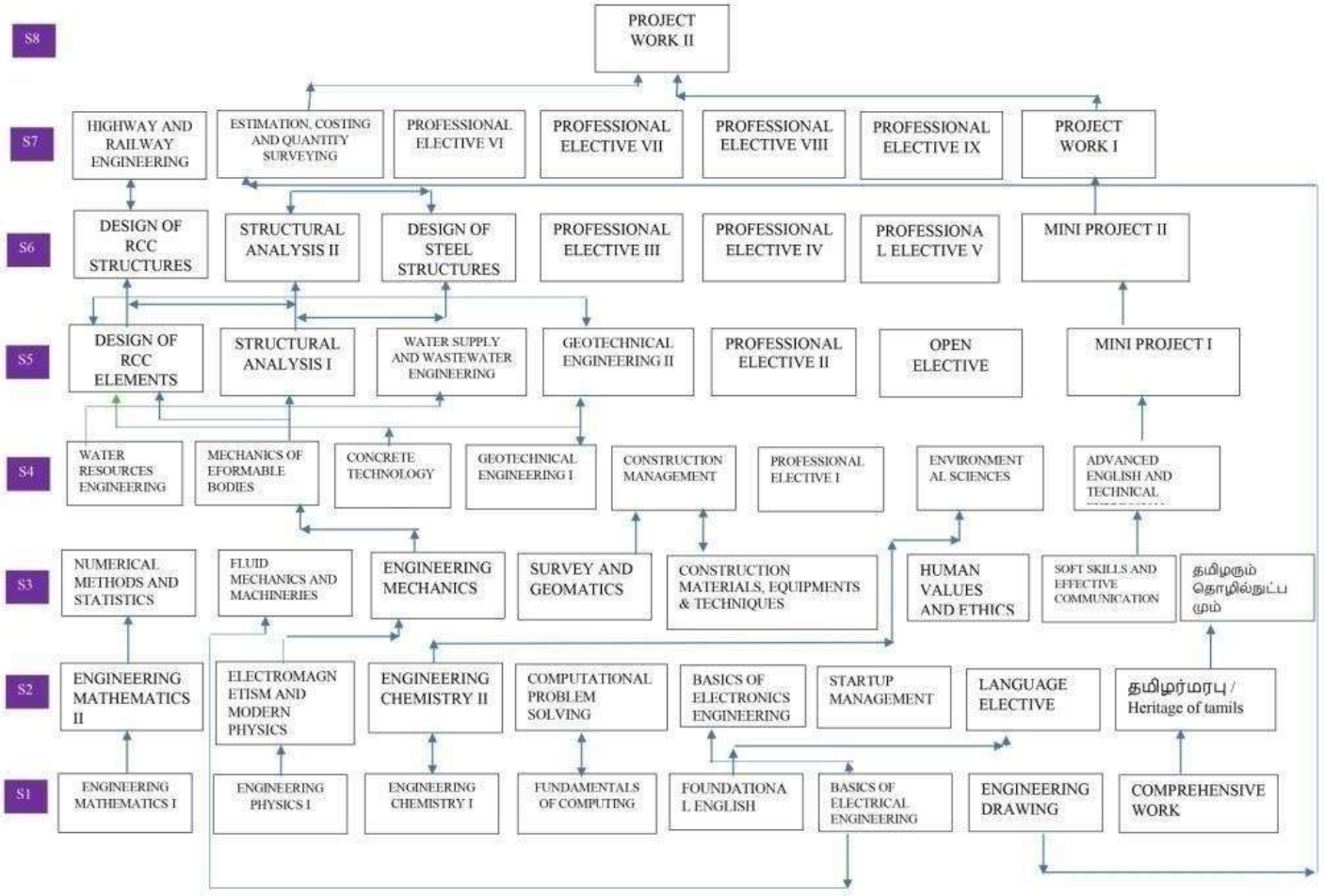
PSO2 Graduates will be able to implement various software tools and smart technologies to solve awide range of Civil Engineering problems with innovative research attributes.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)											
	1	2	3	4	5	6	7	8	9	10	11	12
I	x	x	x	x	x				x	x	x	x
II	x	x	x	x	x	x	x	x		x	x	x
III						x	x	x	x	x	x	x

DEPARTMENT OF CIVIL ENGINEERING

COURSE CONNECTIVITY CHART



(Candidates Admitted During the Academic Year 2023-24)

DEPARTMENT OF CIVIL ENGINEERING
Minimum Credits to be Earned: 164

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	50	50	100	HSS
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22GE005	ENGINEERING DRAWING	1	0	2	2	3	100	0	100	ES
*22HS003	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	50	50	100	HSS
	LANGUAGE ELECTIVE	1	0	2	2	3	50	50	100	HSS
*22HS006	தமிழர் மரபு TAMILS AND TECHNOLOGY	1	0	0	1	1	100	0	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	-

* The lateral entry students have to complete these courses during III and IV semester.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE301	NUMERICAL METHODS AND STATISTICS	3	1	0	4	4	40	60	100	ES
22CE302	CONSTRUCTION MATERIALS EQUIPMENT AND TECHNIQUES	2	0	2	3	4	50	50	100	ES
22CE303	SURVEY AND GEOMATICS	3	0	2	4	5	50	50	100	PC
22CE304	FLUID MECHANICS AND MACHINERY	3	0	2	4	5	50	50	100	PC
22CE305	ENGINEERING MECHANICS	3	1	0	4	4	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	EEC
Total		**16**	**2**	**8**	**22**	**26**	**-**	**-**	**-**	**-**
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE401	WATER RESOURCES ENGINEERING	3	1	0	4	4	40	60	100	ES
22CE402	MECHANICS OF DEFORMABLE BODIES	2	1	2	4	5	50	50	100	PC
22CE403	CONCRETE TECHNOLOGY	3	0	2	4	5	50	50	100	PC
22CE404	GEOTECHNICAL ENGINEERING I	3	0	2	4	5	50	50	100	PC
22CE405	CONSTRUCTION MANAGEMENT	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
22HS007	ENVIRONMENTAL SCIENCES	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
Total		**19**	**2**	**10**	**24**	**31**	-	-	-	-

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE501	DESIGN OF RCC ELEMENTS	3	1	0	4	4	40	60	100	PC
22CE502	STRUCTURAL ANALYSIS I	3	1	0	4	4	40	60	100	PC
22CE503	WATER SUPPLY AND WASTEWATER ENGINEERING	3	0	2	4	5	50	50	100	PC
22CE504	GEOTECHNICAL ENGINEERING II	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CE507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**18**	**2**	**4**	**22**	**24**	**-**	**-**	**-**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE601	DESIGN OF RCC STRUCTURES	3	1	0	4	5	40	60	100	PC
22CE602	STRUCTURAL ANALYSIS II	3	1	0	4	4	40	60	100	PC
22CE603	DESIGN OF STEEL STRUCTURES	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
22CE607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**18**	**2**	**4**	**22**	**25**	**-**	**-**	**-**	**-**
VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE701	HIGHWAY AND RAILWAY ENGINEERING	3	0	2	4	5	50	50	100	PC
22CE702	ESTIMATION, COSTING AND QUANTITY SURVEYING	3	1	0	4	4	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
22CE707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**18**	**1**	**6**	**22**	**25**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

(Candidates Admitted During the Academic Year 2022-23)

DEPARTMENT OF CIVIL ENGINEERING
Minimum Credits to be Earned: 164

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	50	50	100	HSS
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22GE005	ENGINEERING DRAWING	1	0	2	2	3	100	0	100	ES
22CE108	COMPREHENSIVE WORK	0	0	2	1	2	100	0	100	EEC
Total		**14**	**1**	**12**	**21**	**27**	**-**	**-**	**-**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	50	50	100	HSS
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
*22HS003	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	**-**	**-**	**-**	**-**

* The lateral entry students have to complete this course during IV semester.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE301	NUMERICAL METHODS AND STATISTICS	3	1	0	4	4	40	60	100	ES
22CE302	CONSTRUCTION MATERIALS EQUIPMENT AND TECHNIQUES	2	0	2	3	4	50	50	100	ES
22CE303	SURVEY AND GEOMATICS	3	0	2	4	5	50	50	100	PC
22CE304	FLUID MECHANICS AND MACHINERY	3	0	2	4	5	50	50	100	PC
22CE305	ENGINEERING MECHANICS	3	1	0	4	4	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	EEC
22HS006	தமிழர் மரபு TAMILS AND TECHNOLOGY	1	0	0	1	1	40	60	100	EEC
Total		**17**	**2**	**8**	**23**	**27**	-	-	-	-

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE401	WATER RESOURCES ENGINEERING	3	1	0	4	4	40	60	100	ES
22CE402	MECHANICS OF DEFORMABLE BODIES	2	1	2	4	5	50	50	100	PC
22CE403	CONCRETE TECHNOLOGY	3	0	2	4	5	50	50	100	PC
22CE404	GEOTECHNICAL ENGINEERING I	3	0	2	4	5	50	50	100	PC
22CE405	CONSTRUCTION MANAGEMENT	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
22HS007	ENVIRONMENTAL SCIENCES	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
Total		**19**	**2**	**10**	**24**	**31**	-	-	-	-

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE501	DESIGN OF RCC ELEMENTS	3	1	0	4	4	40	60	100	PC
22CE502	STRUCTURAL ANALYSIS I	3	1	0	4	4	40	60	100	PC
22CE503	WATER SUPPLY AND WASTEWATER ENGINEERING	3	0	2	4	5	50	50	100	PC
22CE504	GEOTECHNICAL ENGINEERING II	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CE507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**18**	**2**	**4**	**22**	**24**	**-**	**-**	**-**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE601	DESIGN OF RCC STRUCTURES	3	1	0	4	5	40	60	100	PC
22CE602	STRUCTURAL ANALYSIS II	3	1	0	4	4	40	60	100	PC
22CE603	DESIGN OF STEEL STRUCTURES	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
22CE607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**18**	**2**	**4**	**22**	**25**	**-**	**-**	**-**	**-**
VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CE701	HIGHWAY AND RAILWAY ENGINEERING	3	0	2	4	5	50	50	100	PC
22CE702	ESTIMATION, COSTING AND QUANTITY SURVEYING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
22CE707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**17**	**1**	**6**	**21**	**24**	**-**	**-**	**-**	**-**
VIII SEMESTER										

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CE801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

LANGUAGE ELECTIVES

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Categor y
							CIA	SEE	Total	
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
22HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
22HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
22HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS

PROFESIONAL ELECTIVES

VERTICAL I- MODERN STRUCTURES

1	22CE001	REPAIR AND REHABILITATION OF STRUCTURES	3	0	0	3	3	40	60	100	PE
2	22CE002	PRESTRESSED CONCRETE STRUCTURES	3	0	0	3	3	40	60	100	PE
3	22CE003	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	3	0	0	3	3	40	60	100	PE
4	22CE004	BRIDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
5	22CE005	TALL STRUCTURES	3	0	0	3	3	40	60	100	PE
6	22CE006	STRUCTURAL HEALTH MONITORING	3	0	0	3	3	40	60	100	PE
VERTICAL II – ADVANCED DESIGN													
7	22CE007	DESIGN OF TIMBER AND MASONRY ELEMENTS	3	0	0	3	3	40	60	100	PE
8	22CE008	ADVANCED RC DESIGN	3	0	0	3	3	40	60	100	PE
9	22CE009	ADVANCED STEEL DESIGN	3	0	0	3	3	40	60	100	PE
10	22CE010	INDUSTRIAL STRUCTURES	3	0	0	3	3	40	60	100	PE
11	22CE011	FINITE ELEMENT ANALYSIS	3	0	0	3	3	40	60	100	PE
12	22CE012	STEEL CONCRETE COMPOSITE STRUCTURES	3	0	0	3	3	40	60	100	PE
VERTICAL III- CONSTRUCTION TECHNIQUES AND PRACTICES													
13	22CE013	BUILDING SERVICES	3	0	0	3	3	40	60	100	PE
14	22CE014	CONCEPTUAL PLANNING AND BYE LAWS	3	0	0	3	3	40	60	100	PE
15	22CE015	COST EFFECTIVE CONSTRUCTION AND GREEN BUILDING	3	0	0	3	3	40	60	100	PE
16	22CE016	PREFABRICATED STRUCTURES AND PRE-ENGINEEREDBUILDING	3	0	0	3	3	40	60	100	PE
17	22CE017	ENERGY EFFICIENT BUILDINGS	3	0	0	3	3	40	60	100	PE
18	22CE018	CONSTRUCTION MANAGEMENT AND SAFETY	3	0	0	3	3	40	60	100	PE

VERTICAL IV- GEOTECHNICAL APPLICATIONS											
19	22CE019	GROUND IMPROVEMENT TECHNIQUES	3	0	0	3	3	40	60	100	PE
20	22CE020	GEOENVIRONMENTAL ENGINEERING	3	0	0	3	3	40	60	100	PE
21	22CE021	INTRODUCTION TO GEOTECHNICAL EARTHQUAKE ENGINEERING	3	0	0	3	3	40	60	100	PE
22	22CE022	REINFORCED SOIL STRUCTURES	3	0	0	3	3	40	60	100	PE
23	22CE023	ROCK MECHANICS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
24	22CE024	EARTH RETAINING STRUCTURES	3	0	0	3	3	40	60	100	PE
VERTICAL V- TRANSPORTATION AND GEO-INFORMATICS											
25	22CE025	URBAN TRANSPORTATION PLANNING AND SYSTEMS	3	0	0	3	3	40	60	100	PE
26	22CE026	MASS TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
27	22CE027	TRAFFIC ENGINEERING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
28	22CE028	AIRPORT DOCKS AND HARBOUR	3	0	0	3	3	40	60	100	PE
29	22CE029	TOTAL STATION AND GPS SURVEYING	3	0	0	3	3	40	60	100	PE
30	22CE030	REMOTE SENSING AND GIS	3	0	0	3	3	40	60	100	PE
VERTICAL VI- ENVIRONMENTAL ASPECTS											
31	22CE031	AIR POLLUTION CONTROL AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
32	22CE032	SOLID WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
33	22CE033	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	3	40	60	100	PE
34	22CE034	ENERGY SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	PE
35	22CE035	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
36	22CE036	HAZARDOUS WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VII – COMPUTER APPLICATION											
37	22CE037	APPLICATIONS OF NUMERICAL METHODS IN CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
38	22CE038	APPLICATION OF PYTHON FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
39	22CE039	INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
40	22CE040	APPLICATION OF MATLAB FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
41	22CE041	APPLICATION OF R PROGRAMMING IN CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
42	22CE042	RISK ASSESSMENT AND SAFETY MANAGEMENT	3	0	0	3	3	40	60	100	PE
HONOUR VERTICAL COURSES											
1	22CEH14	CONCEPTUAL PLANNING AND BYE LAWS	3	0	0	3	3	40	60	100	PE
2	22CEH15	COST EFFECTIVE CONSTRUCTION AND GREEN BUILDING	3	0	0	3	3	40	60	100	PE
3	22CEH16	PREFABRICATED STRUCTURES AND PRE-ENGINEEREDBUILDING	3	0	0	3	3	40	60	100	PE
4	22CEH17	ENERGY EFFICIENT BUILDINGS	3	0	0	3	3	40	60	100	PE
5	22CEH18	CONSTRUCTION MANAGEMENT AND SAFETY	3	0	0	3	3	40	60	100	PE
6	22CEH30	REMOTE SENSING AND GIS	3	0	0	3	3	40	60	100	PE

MINOR VERTICAL COURSES											
1	22CEM31	AIR POLLUTION CONTROL AND MANAGEMENT	3	0	0	3	3	40	60	100	ME
2	22CEM32	SOLID WASTE MANAGEMENT	3	0	0	3	3	40	60	100	ME
3	22CEM33	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	3	40	60	100	ME
4	22CEM34	ENERGY SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	ME
5	22CEM35	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	40	60	100	ME
6	22CEM36	HAZARDOUS WASTE MANAGEMENT	3	0	0	3	3	40	60	100	ME
OPEN ELECTIVES											
1	22OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
2	22OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
3	22OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
4	22OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
5	22OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
6	22OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
7	22OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
8	22OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
9	22OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
10	22OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
11	22OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
12	22OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
13	22OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
14	22OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
15	22OGE04	NATION BUILDING: LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variablemodels
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2										
2	2	2										
3	2	1										
4	2	2										
5	1	2										

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression -Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum ofsquares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orhtogonality - Canonical form and itsnature

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponentialgrowth or decline - Exponential equations have a variable as an exponent and take the form y = abx through least square approximation - Calculus of exponential functions - Exponential series – Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Total: 45+15=60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna,2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 ENGINEERING PHYSICS **2 0 2 3**

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

PO 1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4 Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life–long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	1	1					2			1
2	3	2	1	2					2			1
3	3	2	2	1					2			1
4	3	2	2	1					2			1
5	3	2	2	1					2			1

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kineticand potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forcedoscillations - natural frequency - resonance

UNIT III **6 Hours**

PROPAGATION OF ENERGY

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Dopplereffect. Sound waves and its types - characteristics - human voicere - reflection - refraction – beats

UNIT IV **7 Hours**

EXCHANGE OF ENERGY

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

5 Hours

EXPERIMENT 1

Assess the physical parameters of different materials for engineering applications like radius,thickness and diameter to design the electrical wires, bridges and clothes

5 Hours

EXPERIMENT 2

Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles

5 Hours

EXPERIMENT 3

Analyze the photonic behavior of thin materials for advanced optoelectronic applications like adjusting a patient's head, chest and neck positions as a medical tool

5 Hours

EXPERIMENT 4

Investigate the phonon behavior of poor conductors for thermionic applications like polymer materials and textile materials

5 Hours

EXPERIMENT 5

Assess the elongation of different solid materials for industrial applications like buildings, bridges and vehicles

5 Hours

EXPERIMENT 6

Measure the compressibility of different liquids for modern industrial applications like navigation, medicine and imaging

Reference(s)

Total: 60 Hours

1. 1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. 2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. 3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. 4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. 5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH103 ENGINEERING CHEMISTRY I **2 0 2 3**

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	1										
2	2	1										
3	2	1										
4	2	1										
5	2	1										

UNIT I **6 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

UNIT II **6 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER

Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

2 Hours

LABORATORY EXPERIMENTS

Lab safety rules and guidelines for students - OSHA Guidelines

4 Hours

EXPERIMENT 1

Evaluate the dissolved oxygen (DO) levels in effluent samples collected from sewage treatment plants in BIT. Ensure the suitability of outlet water for the growth of aquatic animals (fishes).

4 Hours

EXPERIMENT 2

Investigate the amount of Iron (Fe^{2+}) in a mild steel alloy sample using a spectrophotometer.

4 Hours

EXPERIMENT 3

Estimate the amount of chromium present in industry effluent samples and bottled beverages.

4 Hours

EXPERIMENT 4

Ensure the suitability of drinking water in the RO water supply in BIT based on the presence of chloride ions.

4 Hours

EXPERIMENT 5

Assess the acidic nature of effluent water from industries using the conductometric titration method.

4 Hours

EXPERIMENT 6

Measure the stain removal efficiency of the prepared soaps from stained clothes.

4 Hours

EXPERIMENT 7

Assess the purity of commercially available active pharmaceutical ingredients (aspirin) as per the government-prescribed standards.

Total: 60 Hours

Reference(s)

1. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, 2nd Edition, Oxford university press, 2020.
2. Peter Atkins, Julio D Paula and James Keeler, Atkins' Physical Chemistry, 12th Edition, Oxford university press, 2019.
3. Gareth Price, Thermodynamics of chemical processes, 2nd Edition, Oxford university press, 2019.
4. D Tabor, Gases, liquids and solids and other states of matter, 3rd Edition, Oxford University press, 2018.
5. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017.
6. J.D. Lee, Concise inorganic chemistry, 5th edition (Reprint), Blackman Science Ltd, France, Wiley-India, 2016.

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO2 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfertechniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										1
3	2	2	2	1										
4	2	2	2	1										2
5	2	2	2	1										

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes -Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - flow, functions andcontrols - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simpleprograms.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers,Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor &Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed From The Ground Up", The InternetTechnical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley& Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner"s Approach", McGraw Hill International edition,Seventh edition, 2010.

22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1									2	3		1
2									2	3		1
3									2	3		1
4									2	3		1
5									2	3		1

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction - Recreating Interview Scenarios (with a focus on verbal communication) - Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs - Self-Introduction - Recreating interview scenarios - Haptics - Gestures - Proxemics - Facial expressions - Paralinguistics/Vocalics - Body Language - Appearance - Eye Contact - Artefacts Self- Introduction - Powerful openings and closings at the interview - Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH Questions - Prepositions - Listening to Ted talks- Listening for specific information.

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression - Picture Description and Blog Writing - Vocabulary - One word substitution - Adjectives - Similes, Metaphors, Imagery & Idioms - Link words - Inclusivelanguage. Narrative Expression - Travelogue and Minutes of Meeting -Verbal analogy -Sequence & Time order words - Jumbledparagraph, sentences, Sequencing - Text & Paragraph completion - Past tense - Using quotation marks

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails - Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to Newspapers - Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence-Subject of a mail, Header, Body (Salutation) and Footer of a mail.Conjunctional clause Punctuation - Formal Idioms - Phrases - Articles - Definite & Indefinite - Types of sentences - Modal verbs Precision in comprehension, Summary writing, Selective summary - Reading: Active reading - short paragraphs, excerpts, articles and editorials –Skimming and Scanning Reading comprehension & analysis -Tenses,QP/PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal - Note - taking - Listening: Listening for data, for specific information, for opinion -Active and passive Listening - Transcription - Paraphrasing and summarising information-Agreeing & disagreeing - Note - taking - Writing: Summary writing, selective summary, paraphrasing, note - making, opinion pieces –Finding synonyms in the context Paraphrasing - Sentence Transformation - simple, compound, complex. Sentence substitution - Sentence completion - Interpreting paragraphs

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students:with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE003 BASICS OF ELECTRICAL ENGINEERING **2 0 2 3**

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to thesolution of complex engineering problems.

PO2.Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2		1								
2	1	2		1								
3	1	1										
4	1	2										
5	1	2		1								

UNIT I **5 Hours**

ELECTRIC CHARGE

Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges,Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

EXPERIMENT 1 **15 Hours**

Analyze and design of Electromechanical energy conversion system.

EXPERIMENT 2 **15 hours**

Develop an electrical machine and analyze its performance with supplied input of AC from 0 V to 230 V.

Total: 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) PrivateLimited 2017

22GE005 ENGINEERING DRAWING **1 0 2 2**

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO 2. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simple solids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from isometric view and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3								1	3				2
2	2								1	3				1
3	2								1	3				2
4	3								1	3				2
5														

UNIT I **7 Hours**

FUNDAMENTALS OF ENGINEERING DRAWING

Definition - standards - drawing tools - drawing sheets - scales - line and its types. Practices on lettering - numbering -dimension of drawings. Construction of conic sections - ellipse - parabola and hyperbola using eccentricity method.

UNIT II **9 Hours**

PROJECTION OF POINTS AND LINES

Principles of projection - projection of points in four quadrants - first angle projection of straight lines - perpendicular to one plane - parallel and inclined to both planes.

UNIT III **9 Hours**

PROJECTION OF PLANES AND SOLIDS

Projection of simple planesand projectionof simple solids - parallel - perpendicular and inclined to one plane using changeof position method - inclined to both the planes

UNIT IV **9 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids - simple position with cutting plane parallel - perpendicular and inclined to one plane with true shape ofsection. Development of surfaces - simple and truncated solids.

UNIT V **11 Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projectionsand isometric view of components used in engineering applications.

Total: 45 Hours

Reference(s)

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2019.
2. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
3. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
4. Basant Agarwal, Mechanical drawing, Tata McGraw-Hill Education, 2013.
5. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards - Sp46, 2013.

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures
- Examine the role of sports and games in promoting cultural values and community bonding
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledgeand culture

Programme Outcomes (POs)

PO 9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1									2	3		
2									2	3		
3									2	3		
4									2	3		
5									2	3		

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

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 **3 Hours**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts- Art of temple car making - Massive Terracottasculptures, 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 **3 Hours**

FOLK AND MARTIAL ARTS

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

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

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 **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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 Hours

Reference(s)

1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute ofTamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu TextBook and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

22HS003 **தமிழர் மரபு** **1 0 0 1**

பாடத்திட்டத்தின் நோக்கம்

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

கற்றலின் விளைவு

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.
4. தமிழ் மொழியின் சிறப்புகளை அதன் படைப்பிலக்கியங்கள் மூலம் அறிந்து கொள்ளுதல்.
5. கற்காலம் தொடங்கி, இக்காலம் வரை சிற்பக்கலை அடைந்த வளர்ச்சியை கண்டுகொள்ளல் .
6. தமிழர் தம் வாழ்வில் எங்கனம் இயற்கையை வணங்கி போற்றினர் என்பதை திணை கோட்பாட்டின் வழி தெளிதல்.
7. இந்திய விடுதலை போரில் தமிழர் ஆற்றிய பங்கினை தெரிந்து கொள்ளுதல்.

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

22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamentalprinciples of complex functions

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications inengineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2										
2	2	2										
3	2	2										
4	2	1										
5	1	2										

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables - Cooling/Heating of an object - A falling object - Modeling of electric circuits: RL and RC circuits - Modeling of populationdynamics: Exponential growth and decay - Logistic growth model

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonicmotion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surfaceintegrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

Total: 45 + 15 = 60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies.Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage,2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS 2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

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

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO4 Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life–long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	1	1					2			1
2	3	2	1	2					2			1
3	3	2	2	1					2			1
4	3	2	2	1					2			1
5	3	2	2	1					2			1

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy- Capacitor-Conductors andInsulators - Electric dipole and polarization - Electric current - Voltage sources - Resistance

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism - Monopoles - Magnetic field and force - magnetic field and current distribution - Magnetic dipole -Magnetic potential energy - Inductor - Electric and magnetic field comparison

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: Basic laws - Electromagnetic energy - radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical optics-Human eye - Diffraction - Interference - Polarization – LASER

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation. Matter waves - De-Broglie hypothesis - Wave nature of particles

6 Hours

UNIT V

ENERGY BANDS IN SOLIDS

Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy -Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity

5 Hours

EXPERIMENT 1

Analysis a I-V characteristics of a solar cell for domestic applications

5 Hours

EXPERIMENT 2

Determine the carrier concentration of charge carriers in semiconductors for automotive applications

5 Hours

EXPERIMENT 3

Investigate the photonic behavior of laser source for photo copier device

5 Hours

EXPERIMENT 4

Determination of particle size using diode laser

5 Hours

EXPERIMENT 5

Assess the variation of refractive index of glass and water for optical communication

5 Hours

EXPERIMENT 6

Evaluate the band gap energy of semiconducting materials for display device applications

Reference(s)

Total: 60 Hours

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

PO1 . Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Understand the mechanism of corrosion and suggest a method to control the corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	1										
2	2	1										
3	2	1					1					
4	2	1										
5	2	1										

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - recent applications of radioactive isotopes.

4 Hours

EXPERIMENT 1

Measure industrial effluent water pH and assess water quality against allowed standards

4 Hours

EXPERIMENT 2

Iron (Fe^{2+}) in Bhavani River water: Potentiometric Analysis

4 Hours

EXPERIMENT 3

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light

5 Hours

EXPERIMENT 4

Evaluate the corrosion percentage in concrete TMT bars

4 Hours

EXPERIMENT 5

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors

4 Hours

EXPERIMENT 6

Electroplating of copper metal on iron vessels for domestic application

5 Hours

EXPERIMENT 7

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts

Total: 60 Hours

Reference(s)

1. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, 2nd Edition, Wiley- VCH, 2017.
2. S. Vairam, Engineering Chemistry, 1st Edition, John Wiley & Sons, 2014.
3. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
4. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition (revised), New Age International Publishers, 2011.
6. E. McCafferty, Introduction to Corrosion Science, 1st Edition, Springer, 2010.

22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problemsolving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	1	1	2								
2	3	3	3	3								
3	2	2	2	3								
4	2	2	2	2								
5	2	2	2	2								

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database - Data Read & Write in Local Storage, Server Storage and Cloud storage - Database QueryMethods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - NetworkSecurity - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor &Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia,2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE004 BASICS OF ELECTRONICS ENGINEERING 2 0 2 3

Course Objectives

- To Understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To Analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PSO2 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
1	3	2										1
2	1	1										1
3	1	1										
4	1	2										1
5	1	1										

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energythrough PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energyconversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

4 Hours

EXPERIMENT 1

Design and Implement a simple device to communicate basic information between two different small distance pointsusing wired and wireless methods.

6 Hours

EXPERIMENT 2

Design and Implement different wave shaping Circuits using PN Junction Diodes.

4 Hours

EXPERIMENT 3

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

4 Hours

EXPERIMENT 4

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

4 Hours

EXPERIMENT 5

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

4 Hours

EXPERIMENT 6

Design and Implement Basic Logic Gates using PN Junction Diodes.

4 Hours

EXPERIMENT 7

Design and Implement Basic Logic Gates using BJTs.

Total: 60 Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, OxfordUniversity Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

22HS002 STARTUP MANAGEMENT **1 0 2 2**

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

Programme Outcomes (POs)

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects andin multidisciplinary environments.

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1							1	2	1		1	
2							2	2	1	1	2	
3							3	3	1	2	2	
4							1	3	1	2	2	
5							2	3	2	2	2	

UNIT I **3 Hours**

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas,Tools for validating ideas, Role of Innovation and Design Thinking

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, ValueProposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods - Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, RefiningPrototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting,Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

3 Hours

UNIT V

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

EXPERIMENT 1 **1 Hours**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hours**

Creating Buyer Personas

EXPERIMENT 4 **3 Hours**

Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **2 Hours**

Preparation of Business Model Canvas

EXPERIMENT 6 **15 Hours**

Developing Prototypes

EXPERIMENT 7 **2 Hours**

Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**

Preparation of Business Plans

EXPERIMENT 9 **2 Hours**

Preparation of Pitch Decks

Total: 15+30=45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group,2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS003 HERITAGE OF TAMILS **1 0 0 1**

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures
- Examine the role of sports and games in promoting cultural values and community bonding
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

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 **3 Hours**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - MassiveTerracotta 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 **3 Hours**

FOLK AND MARTIAL ARTS

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

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

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 **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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 Hours

Reference(s)

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

22HS006

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 **உற்பத்திக் 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 – சுடுமண மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சானறுகள் – 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 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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balaknshnan) (Published by: RMRL) – Reference Book

22CE301 NUMERICAL METHODS AND STATISTICS 3 1 0 4

Course Objectives

- Understand the methods to solve polynomial equations and Implement the ideas of numerical interpolation
- Develop enough confidence to solve differential equations numerically
- Summarize and apply the concepts of statistics in solving engineering problems

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization tothe solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the basic concepts of solving equations and able to identify the derivative and integration of functions
2. Acquire the knowledge of solving various types of ordinary and partial differential equations, numerically
3. Comprehend the ideas of basics statistics in engineering
4. Apply the knowledge of testing of hypothesis for small and large samples in engineering problems
5. Interpret the knowledge of design of experiments and control charts in the field of Engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	2	3												
4	2	2												
5	2	3												

UNIT I **10 Hours**

NUMERICAL TECHNIQUES FOR SOLVING EQUATIONS, DIFFERENTIATION AND INTEGRATION

Solution of algebraic and transcendental equations - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Jacobis method for inverse matrices- Eigenvalues of a matrix by Power method -Interpolation - Lagranges interpolation - Approximation of derivatives using interpolation polynomials- Numerical integration using Simpsons rule

UNIT II **9 Hours**

SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Solution of ordinary differential equation: Fourth order Runge - Kutta method for solving first order equations - Solution of two-dimensional heat equation: Laplaces and Poissons equations- One dimensional heat flow equation- Solution of One dimensional wave equation

UNIT III **7 Hours**

BASIC STATISTICS

Mean-Median-Mode-Variance and Standard deviation -Covariance - Correlation and Regression

UNIT IV **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions-Estimation of parameters- Statistical hypothesis-large sample tests based on Normal distribution forsingle mean and difference of means-Tests based on t, Chi-square and F distributions-Chi -square distributions (test for independent and Goodness of fit)

UNIT V **10 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHARTS

One way and two-way classifications-Completely randomized design-Randomized block design-Latin square design- 2X2 factorial design-Control Charts of Variable and Attributes

Total: 45 +15 = 60 Hours

Reference(s)

1. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009
2. Jain M.K, Iyangar S.R.K and Jain R.K Numerical Methods For Scientific and Engineering Computation New Age International (P) Ltd , New Delhi , 2005.
3. William Navidi, Statistics for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill, 2008.
4. Richard A Johnson, Miller and Feunds Probability and Statistics for Engineers, 8thEdiion, Phi Learning PrivateLtd, 2014.
5. Seymour Lipschuts, Introduction to Probability and Statistics, 1st Ediion, McGraw Hill, 2012.

22CE302 CONSTRUCTION MATERIALS EQUIPMENT AND TECHNIQUES **2 0 2 3**

Course Objectives

- To equip the students to have a clear understanding of building materials and their properties.
- To introduce students to new topics such as Expansion joints.
- To introduce students to new topics such as waterproof materials.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the suitable construction practices and equipment for service requirements.
2. Identify the types of modern materials for construction materials.
3. Summarize the importance of substructure in construction techniques.
4. Outline the procedure for superstructure in construction techniques.
5. Indicate the Selection of construction equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2									3	2	1	2
2	2	1									3	1	1	2
3	3	2	-								1	1	1	1
4	1	3									2	3	1	2
5	1	2	1	1							3	2	1	1

UNIT I **6 Hours**

CONSTRUCTION PRACTICES AND SERVICE

Sequence of activities and construction co-ordination, marking, excavation - Types of Foundations - Shallow and Deep Foundations - Brick Masonry - Plastering and Pointing - Cavity Walls - Diaphragm Walls - Formwork - Centering and Shuttering - Shoring - Scaffolding -Underpinning - Roofing - Flooring -Jointsin concrete - Contraction/Construction/Expansion joints - Fire Protection - Thermal Insulation - Ventilation and Air conditioning
- Acoustics and Sound Insulation - Damp Proofing.

UNIT II **6 Hours**

MODERN MATERIALS

Glass - Ceramics Sealants for joints Fiber glass reinforced plastic Clay products Refractories Composite materials Geopolymer based material Types Applications of laminar composites Fiber Textiles - Geomembranes and Geotextilesfor earth reinforcement.

UNIT III **6 Hours**

SUB STRUCTURE CONSTRUCTION

Techniques of Box jacking - Pipe Jacking - Under water construction of diaphragm walls and Basement - Tunneling techniques - Piling techniques - Well and caisson - Sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, sheet piles - Shoring for deep cutting - Well points Dewatering and stand by Plant equipment for underground open excavation.

UNIT IV **6 Hours**

SUPERSTRUCTURE CONSTRUCTION

Launching girders, bridge decks, offshore platforms - Special forms for shells - Techniques for heavy decks - In-situ prestressing in high rise structures - Erecting light weight components on tall structures Support structure for heavy Equipment and conveyors -Erection of articulated structures, braced domes,and space decks.

UNIT V **6 Hours**

CONSTRUCTION EQUIPMENT

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

EXPERIMENT 1 **5 Hours**

Determination of water absorption for Brick.

EXPERIMENT 2 **5 Hours**

Determination of Water absorption for aggregate.

EXPERIMENT 3 **4 Hours**

Determination of physical properties of Lightweight materials

EXPERIMENT 4 **4 Hours**

Determination of Abrasion test on aggregate

EXPERIMENT 5 **4 Hours**

Determination Crushing test on aggregates

EXPERIMENT 6 **4 Hours**

Determination of strength test on Tiles

EXPERIMENT 7 **4 Hours**

Determination of strength test on Fiber reinforced concrete

Total: 60 Hours

Reference(s)

1. Jha J and Sinha S.K., Construction and Foundation Engineering, Khanna Publishers, 1993.
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers New Delhi, 1988.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 1988.
4. Dr. Mahesh Varma, Construction Equipment and its Planning and Application,Metropolitan Book Company, NewDelhi, 1983.
5. Gambhir, M.L, Concrete Technology, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2004.

22CE303 SURVEY AND GEOMATICS 3 0 2 4

Course Objectives

- To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers.
- To learn the various methods of plane and geodetic surveying to solve the real-world Civil Engineering problems.
- To introduce the concepts of Control Surveying and Astronomical surveying.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization tothesolution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiatedconclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretationofdata, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including predictionand modelling to complex engineering activities with an understanding of the limitations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning inthebroadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructuralprojects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Compute the length, bearing and levelling of the given point using various basic surveying instruments.
2. Enumerate the vertical, horizontal distance and reduced level of any given point using tacheometry and prepare thecontour map.
3. Construct the control points and carry-out the appropriate error corrections for the survey data points.
4. Illustrate the hydrographic survey and construct the circular curves.
5. Represent the concept and principle of modern surveying.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2							2	3	2
2	2	3		2	1							2	3	2
3	2	2			2							1	2	1
4	2	-			2								2	2
5	2				-								2	1

UNIT I **9 Hours**

FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELING

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging. Compass - Types of Compass - Basic Principles- Bearing - Types - True Bearing - Magnetic Bearing. Levelling - Principles and theory of Levelling - Datum - Benchmarks - Temporary and Permanent Adjustments- Methods of Levelling- Booking - Reduction - Sources of errors in Levelling - Curvature and refraction.

UNIT II **9 Hours**

THEODOLITE AND TACHEOMETRIC SURVEYING

Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometry surveying. Contour - Contouring - Characteristics of contours - Methods of contouring - Tacheometric contouring - Contour gradient - Uses of contour plan and map.

UNIT III **9 Hours**

CONTROL SURVEYING AND ADJUSTMENT

Horizontal and vertical control Methods Specifications Triangulation - Baseline Satellite stations - Reduction to centre Trigonometrical levelling - Single and reciprocal observations. Traversing - Gales table. Errors Sources precautions and corrections - Classification of errors True and most probable values Weighted observations Principle of least squares Normal equation

UNIT IV **9 Hours**

HYDROGRAPHIC SURVEY AND CIRCULAR CURVES

Hydrographic Surveying - Tides - MSL - Sounding methods - Engineering project surveys- requirements and specifications, various stages of survey work - Curves: Types - Horizontal curve: Elements of simple circular curve - Setting out simple circular curves by offset.

UNIT V **9 Hours**

GEOMATICS

Total Station: Advantages - Parts and accessories - working principle - Setup - Orientation - Field procedure - Errors and Good practices in using Total Station. GPS Surveying: Different segments - space, control and user segments - satellite configuration - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - Hand Held and Geodetic receivers - data processing.

EXPERIMENT 1 **5 Hours**

Preparation of topographic map using chain and compass of football field, BIT.

EXPERIMENT 2 **5 Hours**

Preparation of topographic map using chain and compass of pongal field, BIT.

EXPERIMENT 3 **5 Hours**

Contour map generation using chain, compass and dumpy level of Agri Research field in front of AS block, BIT.

EXPERIMENT 4 **5 Hours**

Contour map generation using chain, compass and dumpy level of pongal field, BIT.

EXPERIMENT 5 **4 Hours**

Establishing the Ground Control Points (GCP) through GALE's table using theodolite, chain and compass.

EXPERIMENT 6 **4 Hours**

Topographic and stakeout survey using total station of football field, BIT.

EXPERIMENT 7 **2 hours**

Topographic and stakeout survey using total station of pongal field, BIT

Total: 75 Hours

Reference(s)

1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 &2, Pune Vidyarthi GrihaPrakashan, Pune, 2014.
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I &II, Lakshmi Publications Pvt Ltd, New Delhi,2005.
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7th Edition,McGraw Hill, 2001.
4. Bannister and S. Raymond, Surveying, 7th Edition, Longman 2004.
5. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014.

22CE304 FLUID MECHANICS AND MACHINERY 3 0 2 4

Course Objectives

- To impart knowledge on the fluid properties and fluid statics principles
- To introduce the basic concept of fluid kinematics and dynamics
- To calculate the rate of flow and energy losses in flow through pipes and open channels
- To emphasize the concepts of boundary layer theory and the importance of dimensional analysis
- To impart the knowledge of pumps and turbines

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT toolsincluding prediction and modelling to complex engineering activities with an understanding of the limitations
PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

Course Outcomes (COs)

1. Explain the fundamental properties of fluids and methods of pressure measurement in fluid statics
2. Infer fundamentals of fluid kinematics and dynamics and their applications in hydraulic experiments
3. Apply the concept of the boundary layer, Dimensional analysis, and Modal analysis to the fluid structures
4. Assess the performance of a model by dimensional analysis and similitude
5. Compute the efficiency and performance of pumps and turbines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3		2					2				1	
2	3	3		2					2				1	
3	3	2		2					2				1	
4	2	2		2	1				2				1	
5	2	2		2					2				1	

UNIT I **9 Hours**

FLUID PROPERTIES AND FLUID STATICS

Concept of Continuum, Properties of Fluid, Classification of fluids, Types of fluid flow Streamline, Streamlines, and path line, Pascals Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of fluid pressure Manometers, Buoyancy and meta-Centre, Stability analysis and applications

UNIT II **8 Hours**

FLUID KINEMATICS AND DYNAMICS

Continuity equation, Velocity Potential and Stream function, Bernoullis equation, and its applications, Impulse- Momentumprinciple , Impact of Jet , Velocity triangle.

UNIT III **9 Hours**

FLOW THROUGH PIPES AND CHANNELS

Laminar and turbulent flows in circular pipes, Major and Minor losses in pipes, Darcy Weisbach equation, Hagen Poiseuille equation,Multi reservoir problems, pipe network design, Types of open Channel flows, Measurement of discharge in open channels, Notches,Most economical channel section.

UNIT IV **9 Hours**

DIMENSIONAL ANALYSIS AND MODEL TESTING

Buckinghams pitheorem and Application of theorem in fluid flow Reynolds, Froude, and Mach number and their applications in model testing, Boundary layer thickness, Momentum integral equation, Drag and lift, Separation of the boundary layer, and Methods of preventing the boundary layer separation

UNIT V **10 Hours**

HYDRAULIC MACHINES

Centrifugal pumps, Work done, Head developed, Pump output and Efficiencies ,priming - minimum starting speed, performance of multistage pumps, Cavitation, methods of prevention, Pump characteristics, Classification of hydraulic turbines, Pelton wheel, Francis turbine, Kaplan and turbines, Specific speed, Performance characteristics, Selection of turbines, Turbine efficiencies

6 Hours

EXPERIMENT 1

Find the coefficient of discharge by suitable device that is most accurate to measure the fuel and air distribution in the carburetor of an IC engine in a two wheeler Also, in Pasteurization and Sterilization process. Discuss the effects of the Reynolds number and friction factor in relation to the rate of flow.

3 Hours

EXPERIMENT 2

Analyze the friction factor of various pipes in a distribution of a water supply for domestic applications

3 Hours

EXPERIMENT 3

Determine the coefficient of discharge by suitable device used to monitor and control the flow of water and chemicals inwater treatment plants

3 Hours

EXPERIMENT 4

Analyze the Lift and drag force of an aero foil design used in a windmill for power generation

3 Hours

EXPERIMENT 5

Conduct the performance test of a suitable turbine that is used to extract energy from waterfalls whose water dropsdown from a height of about 500 m to generate power in Hydropower station

6 Hours

EXPERIMENT 6

Conduct the test from which electricity is to be generated has its reservoir fully filled up during the rainy seasonand the level drops down during summer. A turbine has to be put up such that it can accommodate both cases in a hydropower station

6 Hours

EXPERIMENT 7

Determine the efficiency of a pump to pump water to a very high elevation, say >300 ft, and high viscous fluid usedfor an irrigation and Chocolate Industry

Total: 75 Hours

Reference(s)

1. Yunus A Cengel, and John M Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill Education (India) Pvt Ltd,2014
2. Dr R.K. Bansal , A textbook of Fluid Mechanics and Hydraulic Machines, Tenth Edition, LaxmiPublications, NewDelhi, 2018
3. Frank M White, Fluid Mechanics, McGraw Hill Publishing Company Ltd, New Delhi, 8th Edition 2017
4. R C Hibbler, Fluid Mechanics, Pearson, First edition, 2017
5. S K Som and G Biswas, Introduction to Fluid Machines, 3rd Edition, McGraw-Hill Education 2017
6. https://nptel.ac.in/courses/112105183.

22CE305 ENGINEERING MECHANICS 3 1 0 4

Course Objectives

- To make the students to apply static equilibrium of rigid bodies both in two dimensions and also in three dimensions.
- To comprehend the effect of friction on equilibrium.
- To understand the geometrical properties of surfaces and solids.
- To understand various terms involved in Projectiles.
- To apply dynamic equilibrium of particles in solving basic problems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Explain the different principles of mechanics and to solve engineering problems dealing with forces.
2. Apply the concepts of friction to solve various problems dealing with friction.
3. Explain the different geometrical properties of various sections.
4. Solve problems in rigid body dynamics (kinematic systems).
5. Solve problems in rigid body dynamics (kinetic systems).

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												1
2	2	1												1
3	2	1												1
4	2	1												1
5	2	1												1

UNIT I **9 Hours**

INTRODUCTION TO MECHANICS AND FORCE CONCEPTS

Principles and Concepts - Laws of mechanics - system of forces - resultant of a force system - Lamis theorem - moment of a force - Varignons theorem - resolution of a force into force and couple - force in space - equilibrium ofa particle in space.

UNIT II **9 Hours**

BASIC STRUCTURAL ANALYSIS ANDFRICTION

Beams and types of beams - Simple Trusses - Method of Joints - Method of Sections. Friction resistance - classification of friction - laws of friction - angle of repose - cone of friction - free body diagram - equilibrium of a body on a rough inclined plane - non concurrent force system - ladder friction - rope friction - wedge friction -virtual work method.

UNIT III **9 Hours**

GEOMETRICAL PROPERTIES OF SECTION

Centroids - determination by integration - moment of inertia - product of inertia - principal moment of inertia of plane areas - radius of gyration - Mass moment inertia of simple solids.

UNIT IV **9 Hours**

BASICS OF DYNAMICS - KINEMATICS

Kinematics and kinetics - displacements, velocity and acceleration - equations of motion - rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration - curvilinear motion of particles - projectiles - angle of projection - range - time of flight and maximum height - kinematics of rigid bodies.

UNIT V **9 Hours**

BASICS OF DYNAMICS - KINETICS

Newtons second law of motion - DAlemberts principle, dynamics equilibrium - work energy equation of particles - law of conservation of energy - principle of work and energy. Principles of impulse and momentum - equations of momentum - laws of conservation of momentum. Impact - time of compression, restitution, collision - co-efficient of restitution - collision of elastic bodies by direct central impact and oblique impact - collision of small body with a massive body - kinetic energy of a particle- kinetics of rigid body rotation.

Total: 45+15=60 Hours

Reference(s)

1. Beer F.P and Johnston Jr. E.R, Vector Mechanics for Engineers (In SI Units): Statics and Dynamics, 11th Edition,Tata McGraw Hill Publishing company, New Delhi, 2017.
2. Bhavikatti S. S. and Rajashekarappa, K.G, Engineering Mechanics, New Age International (P) Limited Publishers,2021.
3. Hibbeller, R.C and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Edition, Pearson Education2010.
4. Irving H. Shames and Krishna MohanaRao. G., Engineering Mechanics - Statics and Dynamics, 4th Edition,Pearson Education, 2006.
5. Meriam J. L. and Kraige L. G, Engineering Mechanics- Statics - Volume 1, DynamicsVolume 2, 5th Edition, JohnWiley & Sons,2006.
6. www.nptel.iitm.ac.in/video.php?subjectId=122104015

22HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society atlarge, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, andgive and receive clear instructions.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, andplay a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3	2	1				
2								3	2	1				
3								3	2	1				
4								3	2	1				
5								3	2	1				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century - Understanding the theory of basic human values and ethics - Openness to change - Self enhancement - Conservation - Self transcendence - Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity - Freedom - Justice - Honesty - Truthfulness - Responsibility – Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness - Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in Nature - Holistic perception of harmony at all levels of existence - Practice Exercises andCase Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin. 2011.
2. Gupta, N. L. Human Values for The 21St Century. India: Anmol Publications Pvt. Limited. 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing.2017.
4. Universal Human Values. (n.p.): Booksclinic Publishing. 2023.
5. A Textbook on Professional Ethics and Human Values. India: New Age International (P) Limited.2007.

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION

0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings Problem Analysis: identify, formulate, review research literature, and analyze complex engineering
problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input.
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and otherdiscourse markers
3. Provide constructive feedback and file logical complaints.
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress inoral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT – I - SELF-EXPRESSION **10 Hours**

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives – Discourse - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT – II - CREATIVE EXPRESSION **10 Hours**

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT – III - FORMAL EXPRESSION **10 Hours**

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Total: 30 Hours

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for IntermediateStudents: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, BarunK.Mitra, Oxford University Press, 2012
6. 6. Business English by Ken Taylor, Orient Blackswal,2011

22CE401 WATER RESOURCES ENGINEERING **3 1 0 4**

Course Objectives

- To impart knowledge on spatial and temporal distribution and hydrologic estimates of water resources.
- To disseminate the knowledge on methods of irrigation and design aspects of hydraulic structures for river andreservoir management.
- To emphasize the need for water resources planning and management.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstratethe knowledge of, and need for sustainable development.
PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve awide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Assess the availability and usage of water resources with inference to the need for water conservation and irrigationwater management.
2. Infer the role of hydrologic components in maintaining stream flow and to estimate the peak discharge using hydrograph analysis.
3. Carry out the selection and design of various irrigation systems including flow diversions using hydraulicstructures.
4. Attribute strategies for sustainable reservoir operation and flood control using reliability, economic analysis andflood routing techniques.
5. Estimate the groundwater availability based on the aquifer properties and to design and test the performance ofwells.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1											1
2	2	2	2											1
3	2	3	2											2
4	2	2	2				1				1			2
5	2	2	3											2

UNIT I **9 Hours**

WATER AVAILABILITY AND USAGE

Hydrologic cycle- Meteorological and hydrological parameters - Water-budget equation - consumptive and non- consumptive water uses - Water requirement by crops - Irrigation efficiency- irrigation scheduling - Water resources survey - Water scarcity and its impacts -Water resources planning - Watershed management - National water policy.

UNIT II **9 Hours**

FUNDAMENTALS OF HYDROLOGY

Types of precipitation Measurements of rainfall Statistical analysis of rainfall data Estimation of losses from precipitation Measurement and estimation of evaporation, transpiration and infiltration estimation of runoff - Stream gauging and rating curves - Hydrograph types, construction and analysis - Peak discharge estimation.

UNIT III **9 Hours**

IRRIGATION CANALS AND HYDRAULIC STRUCTURES

Classification of irrigation methods Types of surface irrigation Classification of canals Design andmaintenance of lined canal Design considerations of flow diversion works and regulators Gravity dams types analysis and maintenance-Types and functions of spillways and energy dissipators - Seepage control and drainage design.

UNIT IV **9 Hours**

RESERVOIR PLANNING AND MANAGEMENT

Single purpose and multipurpose reservoir - Determination of storage capacity and yield - Strategies for reservoir operation - Reservoir reliability - Reservoir sedimentation and desilting - Reservoir flood routing - Muskingum channel routing - Methods of flood control - Flood forecasting and warning - Economic analysis of water resources projects.

UNIT V **9 Hours**

GROUNDWATER HYDROLOGY

Aquifer properties - Darcys law - Dupuits assumptions - Well hydraulics - Steady state models for confined and unconfined aquifers - Pumping test and recuperation test - Estimation of well yield - Construction of open wells and borewells - Well shrouding and well development - Groundwater conservation practices.

Total: 45+15=60 Hours

Reference(s)

1. G. L. Asawa, Irrigation and Water Resources Engineering, New Age Publishers, 2005.
2. B. C. Punmia, Pande B. B. Lal, Ashok Kumar Jain, Irrigation and Water Power Engineering, 16th Edition, Laxmi Publications (P) Ltd, 2009.
3. S. K. Garg, Hydrology and Water Resources Engineering, Khanna Publishers, 23rd revised edition, 2017.
4. S. K. Garg, Irrigation and Hydraulic Structures, Khanna Publishers, 23rd revised edition, 2017.
5. N. N. Basak, Irrigation Engineering, McGraw Hill Education, 2017.
6. S. K. Sharma, Principles and Practices of Irrigation Engineering, S Chand & company Ltd, 1987.

22CE402 MECHANICS OF DEFORMABLE BODIES 2 1 2 4

Course Objectives

- Develop the understanding on the state of stresses and strains in engineering components as a result of differentloading conditions.
- Provide the principles and equations, and necessary tools to analyze structural members under axial loads, bending,shear, and torsion.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization tothesolution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiatedconclusions using first principles of mathematics, natural sciences, and engineering sciences.

PS02 Graduates will be able to implement various software tools and smart technologies to solve awide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Compute the simple stress and strain for one and two dimensional elements.
2. Evaluate Principal stress,strain and analyze thin cylinders.
3. Determine and plot shear force and bending moment diagram for statically determinate beams.
4. Evaluate the slope and deflection of statically determinate beams using different methods.
5. Identify the buckling and stability of columns subjected to axial load, and compute the uniaxial and biaxial bendingmoments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
1	2	2												2
2	1	2												2
3	1	2												
4	1	3												
5	1	3												

UNIT I **6 Hours**

STRESSES AND STRAINS

Stress at a point - Types of stress - Strain at a point - Types of strain - Elastic limit - Hookes law - Modulusof elasticity - Stress-Strain diagram - Stresses in composite bars - Thermal stresses - Poissons ratio Rigidity modulus - Bulk modulus - Relation between elastic constants.

UNIT II **6 Hours**

TWO DIMENSIONAL STATE OF STRESS

Two dimensional state of stress at a point -Normal and shear stresses on any plane -Principal planes and principal stresses - Maximum shear stress - Analytical methods and Mohrs circle method -Two dimensional state of strains at a point - Principal strains and their directions. Thin Cylinder Stresses and deformations in thin walled cylinders and spherical shellsdue to internal pressure.

UNIT III **6 Hours**

BENDING AND STRESSES IN BEAMS

Shear force and bending moment for cantilever, simply supported and over hanging beams for any type of loading - Relationship between rate of loading, shear force and bending moment - Theory of simple bending - Assumptions - Analysis for bending stresses - Load carrying capacity of beams - Flitched beams - Stresses in solid and hollow circular shafts.

UNIT IV **6 Hours**

DEFLECTION OF STATICALLY DETERMINATE BEAMS

Governing differential equation - Macaulays method - Moment area method - Conjugate beam method - Strain energy method.

UNIT V **6 Hours**

COLUMNS AND STRUTS

Columns - Slenderness ratio - Calculation of stresses in short columns due to axial load and uni-axial and biaxial bending moments - Core of the section - Buckling load of long columns - Eulers theory -Different end conditions - Rankine"s formula
- Straight line formula.

4 Hours

EXPERIMENT 1

Tensile test on mild steel rod

4 Hours

EXPERIMENT 2

Compression test on brick and wood

EXPERIMENT 3 **4 Hours**

Torsion test on mild steel rod

EXPERIMENT 4 **4 Hours**

Izod and Charpy impact tests

4 Hours

EXPERIMENT 5

Static bending test on cantilever beam

5 Hours

EXPERIMENT 6

Static bending test on simply supported beam

5 Hours

EXPERIMENT 7

Shear test on Mild steel rod

Total : 60+15=75 Hours

Reference(s)

1. S. Rajput, Strength of Materials, S. Chand & Co., 2014.
2. R. K. Bansal, A Textbook ofStrength of Materials, Laxmi Publications,6th Edition 2015.
3. S. M. A. Kazimi, Solid Mechanics, Tata McGraw Hill Book Co Ltd., 2001.
4. P. Boresi, Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition, 2002.
5. B. S. Basavarajaiah and P. Mahadevappa, Strength of Materials, CBS Publishers & Distributors Pvt. Ltd., 2014.

22CE403 CONCRETE TECHNOLOGY 3 0 2 4

Course Objectives

- To impart a sound technical knowledge on the ingredients of conventional and special concrete.
- To impart basic knowledge on the properties of fresh and hardened concrete.
- To provide basic understanding on the usage of different admixture in enhancing the specific requirements of theconcrete.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadestcontext of technological change.
PS01 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

Course Outcomes (COs)

1. Analyze the properties of concrete ingredients as per IS code.
2. Apply mix proportion principles to design a concrete mix by using IS code.
3. Evaluate the hardened concrete properties.
4. Examine the concrete properties based on the addition of admixtures.
5. Identify the suitable special concrete based on the field requirement.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1									2	2	
2	1	2	3		-							2	2	
3	1	3			2							1	1	
4	1	2	3									1	2	
5	1	2	3									2	2	

UNIT I **9 Hours**

INGREDIENTS OF CONCRETE

Cement - Different types - Chemical composition and Properties - Hydration of cement - Tests on cement - IS Specifications - Aggregates - Classification - Mechanical properties and tests as per BIS -Grading requirements - Water - Quality of waterfor use in concrete.

UNIT II **9 Hours**

ADMIXTURES MIX DESIGN

Accelerators - Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaolin - Effects on concrete properties - Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix- BIS Method of Mix Design - Mix Design Examples.

UNIT III **9 Hours**

MANUFACTURING AND FRESH PROPERTIES

Manufacturing Process - Batching - Mixing - Transporting & placing - Compaction and Placing - Curing finishing - Workability tests - Slump test - Segregation & Bleeding - Ready Mix concrete - Quality control of Ready mix concrete.

UNIT IV **9 Hours**

HARDENED CONCRETE

Hardened concrete properties - Determination of strength Properties of Hardened concrete - Stress- strain curve for concrete - Modulus of elasticity - Durability of concrete - Water absorption - permeability - Corrosion test - Acid resistance - Non Destructive test of Concrete.

UNIT V **9 Hours**

SPECIAL CONCRETE

Lightweight concretes - Foam concrete - Self compacting concrete - Vacuum concrete - High strength concrete - Fiber reinforced concrete - Ferrocement - SIFCON - Shotcrete - Polymer concrete - High performance concrete - Geopolymer Concrete.

EXPERIMENT 1 **2 Hours**

Testing the properties of cement.

EXPERIMENT 2 **3 Hours**

Test on setting time of cement.

EXPERIMENT 3 **3 Hours**

Testing the properties of fine aggregates

EXPERIMENT 4 **4 Hours**

Testing the properties of coarse aggregate

EXPERIMENT 5 **2 Hours**

Mix design of concrete

EXPERIMENT 6 **5 Hours**

Testing the fresh properties of concrete.

EXPERIMENT 7 **2 Hours**

Testing the compressive strength of concrete

EXPERIMENT 8 **2 Hours**

Split tensile strength of concrete

EXPERIMENT 9 **2 Hours**

Flexural strength test of concrete

EXPERIMENT 10 **5 Hours**

Non- destructive testing of hardened concrete

Total: 75 Hours

Reference(s)

1. Concrete Technology, 2nd Edition by A. M. Neville, The Royal Academy of Engineering, J.J. Brooks, Universityof Leeds, Pearson, United kingdom, 2010.
2. Concrete Technology: Theory and Practice, 8/e by M. S. Shetty & A K Jain, S. Chand Publishing, NewDelh, 2019.
3. Concrete: Microstructure, Properties, and Materials, By P. Kumar Mehta, Paulo J. M. Monteiro, McGraw-HillEducatio, 2017.

22CE404 GEOTECHNICAL ENGINEERING I 3 0 2 4

Course Objectives

- To make the students gain adequate knowledge on soil formation and characteristics.
- To make them know the significance of the soil properties.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,andgive and receive clear instructions.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadestcontext of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Classify the soil based on index properties and understand the compaction process.
2. Determine the stress distribution and the permeability of soils.
3. Evaluate the vertical stress due to external loads and consolidation settlement of clayey soils.
4. Compute the shear strength parameters of soils under different drainage conditions.
5. Analyze the stability of slopes and provide slope protection methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		3						1		1	1	1
2	3	3								2		1	1	2
3	3	3								1		1	1	2
4	3	3		3						1		1	1	1
5	3	2	1	2						1		1	1	2

UNIT I **10 Hours**

SOIL FORMATION AND ITS PROPERTIES

Origin of Soils - Three phase system and phase relationships-Index Properties of soils - Clay Mineralogy - Indian Standard Soil classification system. Compaction - Factors affecting compaction - Laboratory & FieldCompaction methods.

UNIT II **10 Hours**

PERMEABILITY AND EFFECTIVE STRESS

Flow of water through soils - Darcys law Assumptions and validity - Permeability - Coefficient of permeability - Factors affecting permeability - Permeability of stratified deposits of soils - Laboratory tests - Seepage analysis. Soil water - Various forms - Static pressure in water - Total - Neutral and effective stress distribution in soils - Liquefaction & quicksand conditions.

UNIT III **10 Hours**

STRESS DISTRIBUTION AND CONSOLIDATION

Boussinesqs and Wester Guards theories of stresses due to concentrated loads - Circular, Rectangular load - Strip load - New Mark"s chart. Consolidation - Fundamental definitions - Spring analogy - Terzaghi""s one- dimensional consolidation theory - Time rate of consolidation - Pre-consolidation pressure and its determination - Normally, under and over consolidated soils.

UNIT IV **8 Hours**

SHEAR STRENGTH OF SOILS

Shear strength - Factors affecting shear strength of soils- Mohr - Coulomb theory - Measurement of shear strength parameters - Direct shear - Unconfined compression - Triaxial - Drained and un- drained conditions - Vane shear tests.

UNIT V **7 Hours**

STABILITY OF SLOPES

Types of slopes - Failure mechanism of slopes - Total and effective stress analysis - Finite slopes - Stability analysis for purely cohesive and c-phi soils - Method of slices - Friction circle method - Taylor"s Stability number - Slope protection methods.

EXPERIMENT 1 **2 Hours**

Grain size distribution Specific Gravity

1. Sieve analysis and Hydrometer analysis
2. Specific gravity of soil grains

EXPERIMENT 2 **4 Hours**

Atterberg limits Test

1. Liquid limit
2. Plastic limit
3. Shrinkage limit

EXPERIMENT 3 **3 Hours**

Conduction of Field density test.

Core cutter and sand replacement methods.

EXPERIMENT 4 **3 Hours**

Determination of moisture - Density relationship using Standard Proctor test

EXPERIMENT 5 **2 Hours**

Estimation of CBR value for pavement design at a given site

EXPERIMENT 6 **2 Hours**

Permeability determination

Constant head and falling head methods

EXPERIMENT 7 **6 Hours**

One dimensional consolidation test

Determination of coefficient of consolidation only

EXPERIMENT 8 **5 Hours**

Determination of shear strength parameters

1. Direct shear test on cohesionless soil
2. Unconfined compression test on cohesive soil
3. Triaxial compression test
4. Vane shear test

EXPERIMENT 9 **3 Hours**

Differential free swell and swell pressure tests

Reference(s) **Total: 75 Hours**

1. Alam Singh, Soil Engineering in Theory and Practice, Asia Publishing House, Bombay, 2nd Edition, 2009.
2. Braja M. Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole, Australia, 8th Edition, 2015.
3. Karl Terzaghi, Soil Mechanics in Engineering Practice, 3rd edition, John Wiley & Sons, Inc, 1995.
4. IS 2720 : Part 1 to Part 41 Methods of Test for soils
5. IS 2720-PART V- 1970 Determination of Liquid limit and Plastic limit
6. IS 2720-PART IV- 1975-Grain size analysis

22CE405 CONSTRUCTION MANAGEMENT 3 0 2 4

Course Objectives

- To impart knowledge on organizing project management and the importance of scheduling procedure techniques
- To impart knowledge on labour materials and equipment utilization

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation ofdata, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO11Demonstrate knowledge and understanding of the engineering and management principles and apply these toones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the owners perspective for project management.
2. Summarise the Effects of Project Risks on Organization.
3. Identify the scheduling procedure and techniques.
4. Indicate the labour, material and equipment utilization.
5. Indicate types Construction Cost Estimates.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	1						1			1
2	3	3	1	1	1									2
3	3	3	1	1	1									2
4	3	3	1	1	1						1			2
5	3	2	1	2	1									2

UNIT I **9 Hours**

INTRODUCTION TO PROJECT MANAGEMENT

Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers.

UNIT II **9 Hours**

ORGANIZING FOR PROJECT MANAGEMENT

Project Management Modern trends Strategic Planning Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team.

UNIT III **9 Hours**

SCHEDULING PROCEDURES AND TECHNIQUES

Construction Schedules Critical Path Method Scheduling Calculations Float Presenting Project Schedules Scheduling for Activity-On-Node and with Leads, Lags, and Windows Scheduling with Resource Constraints and Precedence Use of Advanced Scheduling Techniques.

UNIT IV **9 Hours**

LABOUR, MATERIAL AND EQUIPMENT UTILIZATION

Historical Perspective - Labour Productivity - Factors Affecting Job-Site Productivity - Labour Relations in

Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management. - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks.

UNIT V **9 Hours**

COST ESTIMATION

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs.

EXPERIMENT 1 **3 Hours**

Basics concept of project management tools

EXPERIMENT 2 **3 Hours**

Draw the bar chart of residential building for given construction task

EXPERIMENT 3 **3 Hours**

Design the housing unit project extract from workers requirement for crash program

EXPERIMENT 4 **3 Hours**

Design the Activity and workers requirement for foundation

EXPERIMENT 5 **3 Hours**

Draw the commercial buildings for work- breakdown structure

EXPERIMENT 6 **3 Hours**

Design the network for pumping station and analyse using critical path method

EXPERIMENT 7 **3 Hours**

Determine the activity based on floating method for small scale project

EXPERIMENT 8 **4 Hours**

Estimate the expected activity duration in PERT network

EXPERIMENT 9 **3 Hours**

Determine the standard deviation in normal distribution for a project

Total: 75 Hours

Reference(s)

1. Chitkara K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.

2. Choudhury S, "Project Management", McGraw-Hill Publishing Company, New Delhi, 1988.

3. Chris Hendrickson and Tung Au Project Management for Construction Fundamental Concepts for Owners Engineers Architects and Builders Prentice Hall Pittsburgh 2000.

4. Frederick E. Gould Construction Project Management Wentworth Institute of Technology Vary E. Joyce, Massachusetts Institute of Technology, 2000.

5. George J.Ritz Total Construction Project Management- McGraw-Hill Inc, 1994.

6. P P Dharwadkar Construction management, Oxford IBH Publishing Co Pvt.Ltd, 2 nd edition 1990.

22HS007 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest forsustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO2 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructuralprojects ensuring safety, cost-effectiveness and sustainability.

Course Outcomes (COs)

1. Show the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Demonstrate the different types of ecosystems and biodiversity, its values and also role of professionals inprotecting the environment from degradation
3. Assess the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Compare the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								1	2					1
2								1	2					1
3								1	2					2
4								1	2					2
5								1	3					1

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer - pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources - renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation ofbiodiversity:In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - Water pollution - Sewage water treatment by activated sludge and trickling filter process - Noise pollution - Thermal pollution. Disaster management - causes - effects -control measures of floods - Earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development - Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles - landfills, incineration, composting. Water conservation - rain water harvesting - watershed management. Climate change - Global warming - acid rain - Ozone layer depletion. E-waste

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P. H. Hassenzahl, D.M. & Berg, L.R. 2012. Environment, 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi,2014
4. Pepper, I. L, Gerba, C. P. & Brusseau, M. L. 2011, Environmental and Pollution Science, Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014

22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION 0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing
- Effectively use and appreciate the nuances of the language and engage an audience
- Use advanced tools of language to improve communicative competence and prepare for professional demands at the workplace

Programme Outcomes (POs)

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the clarity in articulating the objectives and aims and improved proficiency in usingthe English language
2. Communicate effectively and with good interpersonal skills; speak in public, engagethe audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writingtechniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **15 Hours**

CREATIVE EXPRESSION

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: 'Why should we hire you?' Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors -Homophones, homonyms, alliteration, wordplay

UNIT II **15 Hours**

FORMAL EXPRESSION

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning

- SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, EfficaciousVocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct TASKs Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHILearning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and PracticeBook for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & KrishnaMohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace &L.Ann Masters, Cengage Learning,New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- MacmillanIndia Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N.K.Agrawal&F.T.Wood, MacmillanIndia Ltd., New Delhi

22CE501 DESIGN OF RCC ELEMENTS **3 1 0 4**

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest forsustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, andenvironmental considerations.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range ofCivil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Illustrate the design concepts as per working stress method.
2. Analyze the behavior of slab and staircase based on the limiting condition.
3. To understand the behavior of flexural elements as per the limit state method.
4. Evaluate the behavior of flexural elements subjected to shear and torsion.
5. To understand the behavior of columns subjected to axial, uniaxial and biaxial moment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										1	
2	2	3	1										1	2
3	2	3	1										1	2
4	2	3	1										1	
5	2	3	1										1	

UNIT I **9 Hours**

WORKING STRESS METHOD

Aims of design - Method of design - Working stress method - Assumptions - Stress strain behavior of steel and concrete - Stress block parameters - Design of singly and doubly reinforced rectangular sections by working stress method.

UNIT II **9 Hours**

LIMIT STATE DESIGN OF SLAB AND STAIRCASE

Limit state method - Principles - Partial safety factor - Design of RC rectangular one and two way slabs subjected to uniformly distributed load by limit state method -Introduction to flat slab - Types of stairs - Design of stairs spanning horizontally - Design of dog legged stair.

UNIT III **9 Hours**

LIMIT STATE DESIGN OF BEAMS FOR FLEXURE

Stress block parameters - Neutral axis for Balanced, Under Reinforced and Over Reinforced Sections - Design of singly reinforced rectangular section - Design of doubly reinforced rectangular section - Design of flanged (T & L) beams.

UNIT IV **9 Hours**

LIMIT STATE DESIGN OF BEAMS FOR SHEAR

Shear forces in beam - Types of shear resistance - Design of vertical stirrups - Design of Bent-up bars - Development length - Design of beams for flexure, shear and torsion (Combined effect) - Parameters considered in limit state of serviceability - Check for deflection and crack width.

UNIT V **9 Hours**

LIMIT STATE DESIGN OF COLUMNS

Types of columns - Provisions of IS-456 code for the design of columns - Design of short columns subjected to axial load, uniaxial and biaxial bending moment - Design of long column subjected to axial load.

Total: 45 + 15 = 60 Hours

Reference(s)

1. B. C. Punmia, A. K. Jain, Limit State Design of Reinforced Concrete, Laxmi Publications, Revised edition (2016).
2. S. Unnikrishna Pillai and Devedas Menon, Reinforced Concrete Design, McGraw Hill Education; 3 edition 2017.
3. S. N. Sinha, Reinforced Concrete Design, McGraw Hill Education (India) Private Limited; 3 edition (New Delhi), April 9, 2014.
4. N. Krishna Raju, Advanced Reinforced Concrete Design (IS: 456-2000), CBS; 3rd edition 2016.
5. P. C. Varghese, Limit State Design of Reinforced Concrete, PHI Learning Pvt. Ltd., New Delhi, 2008.
6. IS 456:2000 (4th Revision) - Plain and reinforced concrete - Code of Practice

22CE502 STRUCTURAL ANALYSIS I 3 1 0 4

Course Objectives

- To impart knowledge on the different methods of analysis of statically indeterminate structures.
- To impart knowledge on moving loads and influence line diagrams.
- To provide a thorough understanding on analysis arches.
- At the end of the course students will be conversant with classical methods of analysis.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to thesolution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiatedconclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in thebroadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructuralprojects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Compute the member forces and deflection of determinate and indeterminate structures.
2. Analyze the bending moment and shear force for beam, sway and non-sway frame by moment distribution method.
3. Identify the vertical reaction, horizontal thrust and bending moment for two and three hinged arches.
4. Represent the ILD for simply supported and overhanging beams subjected to moving load.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1										2	1	2
2	1	2										2	1	1
3	1	2										1	2	2
4	1	2										2	2	3
5	1	3										1	1	2

UNIT I **9 Hours**

ANALYSIS OF DETERMINATE AND INDETERMINATE TRUSS MEMBER

Determination of Static and Kinematic structures - Degree of Freedom - Analysis of plane trusses by method of joint, method of section and tension coefficient method - Deflection of statically determinate pin jointed trusses and rigid jointed frames by energy method and unit load method - Analysis of pin connected indeterminate trusses by consistent deformation method.

UNIT II **9 Hours**

SLOPE DEFLECTION METHOD

Derivation of slope deflection equations - Application to Continuous beams and rigid frames (with and withoutsway) - Effect of Support displacements.

UNIT III **9 Hours**

MOMENT DISTRIBUTION METHOD

Absolute and relative stiffness and carry over factors - Analysis of continuous beams - Plane rigid jointedframes with and without sway - Effect of settlement of supports - Nayler's simplification.

9 Hours

UNIT V

ARCHES

Arches as structural forms - Examples of arch structures - Types of arches - Analysis of three hinged, two hinged and fixed arches having parabolic and circular shapes - Settlement and temperature effects.

UNIT V **9 Hours**

MOVING LOADS AND INFLUENCE LINES

Influence Lines: Introduction - Construction of ILD for shear force and bending moment at a sections- determination of load positions for maximum shear force and bending moments for simply supported and overhanging beams with several point loads and UDL and determination of their values - Sketching of absolute maximum BMD.

Total: 45 + 15 = 60 Hours

Reference(s)

1. Ramez Gayed, Amin Ghali, Structural Analysis Fundamentals Published September 17, 2021
2. SS Bhavikatti, Structural Analysis,Third edition, Volume ISecond Edition Volume II, Vikas Publishing House (p)ltd ,2018
3. Vaidyanathan.R, Perumal.P, Comprehensive Structural Analysis, Vol I & II Laxmi Publications, 2018
4. James Hanson, Structural Analysis: Skills for Practice, Tata McGraw Hill publishing company limited,2022.
5. S. Ramamrutham, Theory of structures, Khanna Publishers, New Delhi, 2015

22CE503 WATER SUPPLY AND WASTEWATER ENGINEERING **3 0 2 4**

Course Objectives

- To impart knowledge on the quality and quantity of water.
- To select a suitable method of water treatment and to find the capacity of a water treatment plant.
- To deliver the knowledge on various systems of collection and treatment of municipal wastewater.
- To emphasize the need for sewage treatment and to impart training to design the various treatment units.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, andenvironmental considerations.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range ofCivil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Estimate the quantity of water and analyse its quality parameters.
2. Design the coagulation, flocculation and sedimentation tanks including intake structures.
3. Design the filtration and disinfection units and select the typical distribution layout.
4. Estimate the quantity of sewage and analyse its characteristics to design sewers including storm water flow.
5. Design the important sewage treatment units including sludge disposal.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										1	2
2	2	2	2										2	1
3	2	3	2										1	2
4	2	2	2										1	2
5	2	2	3										2	3

UNIT I **8 Hours**

QUANTITY AND QUALITY OF WATER

Introduction: Scope for Environmental Engineering - Need for protected water supply - Quantity of Water - Population Forecasting methods - Per capita demand - Types of water demands Characteristics of water with respect to BIS standards - Water borne diseases.

UNIT II **8 Hours**

SOURCE, CONVEYANCE AND TREATMENT OF WATER

Intakes - pipes - Design for the economical diameter of the rising main - Nomograms - Objectivesof water treatment - Typical flow chart of a water treatment plant - Aeration - Sedimentation - Settling tanks -Types - Design of sedimentation tanks.

UNIT III **10 Hours**

FILTRATION, DISINFECTION AND DISTRIBUTION

Filtration Design of Rapid sand and slow sand filters - Disinfection - Distribution- Layouts of distribution system - Distribution reservoirs - Storage capacity of distribution reservoirs - Automation in Water Supply -Water Economics and Pricing.

UNIT IV **9 Hours**

QUANTITY OF SEWAGE

Types of sewerage systems suitability - Dry weather flow - Computation of design flow - Estimation of storm flow -Time of concentration - Design of storm water drain - Characteristics of sewage - Design of Sewers - Sewer Materials - Non Silting and Non Scouring Velocities. Manholes
- Water seal system.

UNIT V **10 Hours**

TREATMENT OF SEWAGE

Types of Treatment - Flow diagram of a typical municipal sewage treatment plant - Primary Treatment -Screening - Grit chambers - Skimming tanks - Primary sedimentation tanks - Sludge deposit - Secondary treatment - Concepts of Aerobic and Anaerobic activity - Trickling filter - Activated sludge process - Secondary sedimentation tanks - Tertiary treatment - Sludge digestion and filter beds - Methods of sludge disposal- Sustainable treatment technologies.

EXPERIMENT 1 **3 Hours**

Determination of Acidity and Alkalinity in the given water/wastewater sample.

EXPERIMENT 2 **3 Hours**

Estimation of Hardness and Chlorides in the given water and wastewater sample.

EXPERIMENT 3 **3 Hours**

Analysis of Sulphates in the given sample.

EXPERIMENT 4 **3 Hours**

Estimation of available chlorine in Bleaching powder and chlorine demand for the given sample

EXPERIMENT 5 **3 Hours**

Determination of pH and Turbidity for the given sample.

EXPERIMENT 6 **3 Hours**

Determination of optimum coagulant dosage for the given sample.

EXPERIMENT 7 **6 Hours**

Estimation of Dissolved Oxygen and Bio Chemical Oxygen Demand for the given water/wastewater sample

EXPERIMENT 8 **6 Hours**

Determination of Chemical Oxygen Demand and Solids(Total and Dissolved - organic and inorganic solids) for the given water/wastewater sample.

Total: 75 Hours

Reference(s)

1. Garg, S.K., Environmental Engineering Vol.I, Water Supply Engineering, Khanna Publishers, New Delhi, 35thEdition, 2021.
2. Garg, S.K.,Environmental Engineering Vol.II, Sewage Disposal and Air Pollution Engineering, Khanna Publishers,New Delhi, 2021.
3. Birdie, G.S. and Birdie, J.S., Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi, 2014.
4. Metcalf and Eddy., 2014. Waste water Engineering, Treatment, Disposal and Reuse, 3rd Edition, Tata McGrawHill, New Delhi.
5. CPHEEO, 2019. Manual on storm water drainage systems Central Public Health and Environment Engineering Organization, Government of India, New Delhi.
6. CPHEEO, 2013. Manual on Sewerage and Sewage Treatment Systems, Central Public Health and Environment Engineering Organization, Government of India, New Delhi.

22CE504 GEOTECHNICAL ENGINEERING II 3 0 0 3

Course Objectives

- To impart fundamental knowledge on investigation of the site and selection of suitable foundation.
- To impart knowledge on the design concepts of different types of foundations & earth retaining structures.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiatedconclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Conduct site investigation and prepare the report for selection of foundation.
2. Compute the bearing capacity and settlement of soil.
3. Evaluate the size of shallow foundations.
4. Estimate the load carrying capacity of piles and settlement of pile groups.
5. Analyze the lateral earth pressure on retaining wall.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	-		1							2	1
2	3	3	1	2									2	1
3	3	3	1										1	2
4	3	3	1			1							1	1
5	3	3	1										2	2

UNIT I **9 Hours**

SITE INVESTIGATION AND SELECTION OF FOUNDATION

Scope & Objectives - Methods of exploration - Depth and spacing of bore holes - Sampling of soil - Methods of sampling - Penetration tests (SPT, SCPT and DCPT) - Interpretation - Bore log report - Requirements of good foundation - Factors governing location and depth of foundation - Types & Selection of foundation.

UNIT II **9 Hours**

SHALLOW FOUNDATION

Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi"s formula and BIS formula - Bearing Capacity from insitu tests (SPT, SCPT and Plate load) - Settlement - Components of settlement - Determination of settlement of foundations on granular and clay deposits - Allowable settlements (As per IS Codal provisions) - Methods of minimizing total and differential settlement.

UNIT III **9 Hours**

FOOTINGS AND RAFT

Contact pressure distribution below footings - Types and uses of shallow footings - Proportioning of Isolated and Combined footings - Strap footings - Principles of design of mat foundation.

UNIT IV **9 Hours**

PILE FOUNDATION

Types of piles and their function - Factors influencing the selection of pile - Carrying capacity of single pilein granular and cohesive soil - Static formula - dynamic formulae (Engineering news and Hiley"s) - Interpretation with in situ tests (SPT, SCPT and Pile load test) - Negative skin friction - Group capacity by different methods (Feld"s rule and block failure criterion) - Settlement of pile groups.

UNIT V **9 Hours**

EARTH PRESSURE

Active and passive earth pressure - Rankine"s theory - Coloumb"s wedge theory - Earth pressure on retaining walls including the effect of surcharge for c and c-phi soil under dry and saturated conditions - Deep excavation support techniques.

Total: 45 Hours

Reference(s)

1. B. N. D. Narasinga Rao, Soil Mechanics and Foundation Engineering, Wiley India Pvt. Ltd., New Delhi, 2015.
2. B. C. Punmia, Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005.
3. Donald P. Coduto, Foundation Design Principles & Practices, 2nd Edition, Prentice-Hall of India, 2001
4. Braja M. Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole, Australia, 8th Edition, 2015.
5. P.C.Varghese, Foundation Engineering, Prentice-Hall of India Private Ltd, New Delhi, 2006

22CE507 MINI PROJECT I **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement, and develop the design solutions.
2. Identify technical ideas, strategies, and methodologies.
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution ofthe project.
4. Test and validate through conformance of the developed prototype and analysis of the cost-effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2	1	1	1	1
2		-	1	1	2			2	2	2	1	1	1	1
3	-		1	1	2			2	2	2	1	1	1	1
4	-		1	1	2			2	2	2	1	1	1	1
5	-	-	-		2			2	2	2	1	1	1	1

22CE601 DESIGN OF RCC STRUCTURES 3 1 0 4

Course Objectives

- To impart a thorough knowledge about the matrix methods of structural analysis.
- To provide a thorough understanding on truss and arches of influence line diagram.
- To impart knowledge on cables and suspension bridges.
- At the end of the course students will be conversant with classical methods of analysis.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze and construct influence line for the trusses and symmetrical arches.

2.Analyze the internal forces in the Cables and Suspension bridges.

3.Compute the forces for continuous beams, frames and trusses using the flexibility method. 4.Determine the displacement for continuous beams, frames and trusses using the stiffness method.5.Analyze beams, frames and trusses by Kani's method and Combined mechanism method.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	3										1	1
2	1	2	3										1	1
3	1	2	3										2	1
4	1	-	3										2	2
5	1	2	3										2	1

UNIT I **9 Hours**

INFLUENCE LINES FOR FORCES IN PLANE TRUSSES AND ARCHES

N type truss - Pratt truss with parallel chords - Pratt truss with inclined chords - Warren truss with inclined chords. Symmetrical arches: Influence lines for horizontal thrust - Influence lines for B.M - Influence lines for S.F, B.M and normal thrust for moving concentrated loads and UDL - Muller Breslau principle.

UNIT II **9 Hours**

CABLES AND SUSPENSION BRIDGES

Components and their Functions - Analysis of cable under concentrated loads and UDL - Shape of cable under self weight - Anchorage of suspension cables - Bending Moment and Shear Force in suspension bridges with three hinged stiffened girders - Maximum Bending Moment due to moving single concentrated load and UDL - Influence lines for Bending Moment and Shear Force - Analysis of suspension bridges with two hinged stiffening girders.

UNIT III **9 Hours**

MATRIX FLEXIBILITY METHOD

Introduction - Computation of flexibility matrices - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

UNIT IV **9 Hours**

MATRIX STIFFNESS METHOD

Introduction - Equilibrium and compatibility - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of kinematic indeterminacy.

UNIT V **9 Hours**

MISCELLANEOUS TOPICS

Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy by Kani's method. Plastic analysis of structures - Assumptions - Moment redistribution - Analysis of fixed and continuous beams and portal frames by mechanism method.

Total: 45+15 =60 Hours

Reference(s)

1. Ramez Gayed, Amin Ghali, Structural Analysis Fundamentals Published September 17, 2021
2. SS Bhavikatti, Structural Analysis,Third edition, Volume I Second Edition Volume II, Vikas Publishing House (p)ltd ,2018
3. Vaidyanathan.R, Perumal.P, Comprehensive Structural Analysis, Vol I & II Laxmi Publications, 2018
4. James Hanson, Structural Analysis: Skills for Practice, Tata McGraw Hill publishing company limited,2022.

22CE602 STRUCTURAL ANALYSIS II 3 1 0 4

Course Objectives

- To impart a thorough knowledge about the matrix methods of structural analysis.
- To provide a thorough understanding on truss and arches of influence line diagram.
- To impart knowledge on cables and suspension bridges.
- At the end of the course students will be conversant with classical methods of analysis.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze and construct influence line for the trusses and symmetrical arches.
2. Analyze the internal forces in the Cables and Suspension bridges.
3. Compute the forces for continuous beams, frames and trusses using the flexibility method.
4. Determine the displacement for continuous beams, frames and trusses using the stiffness method.
5. Analyze beams, frames and trusses by Kani"s method and Combined mechanism method.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-										1	1
2	1	1	2										1	1
3	1	2	-										1	1
4	1	2											2	2
5	2	3											2	1

UNIT I **9 Hours**

INFLUENCE LINES FOR FORCES IN PLANE TRUSSES AND ARCHES

N type truss - Pratt truss with parallel chords - Pratt truss with inclined chords - Warren truss with inclined chords. Symmetrical arches: Influence lines for horizontal thrust - Influence lines for B.M - Influence lines for S.F, B.M and normalthrust for moving concentrated loads and UDL - Muller Breslau principle.

UNIT II **9 Hours**

CABLES AND SUSPENSION BRIDGES

Components and their Functions - Analysis of cable under concentrated loads and UDL - Shape of cable under self weight - Anchorage of suspension cables - Bending Moment and Shear Force in suspension bridges with three hinged stiffened girders - Maximum Bending Moment due to moving single concentrated load and UDL - Influence lines for Bending Moment and Shear Force - Analysis of suspension bridges with two hinged stiffening girders.

UNIT III **9 Hours**

MATRIX FLEXIBILITY METHOD

Introduction - Computation of flexibility matrices - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

UNIT IV **9 Hours**

MATRIX STIFFNESS METHOD

Introduction - Equilibrium and compatibility - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of kinematic indeterminacy.

UNIT V **9 Hours**

MISCELLANEOUS TOPICS

Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy by Kani"s method. Plastic analysis of structures - Assumptions - Moment redistribution - Analysis of fixed and continuous beams and portal frames by mechanism method.

Total: 45+15 = 60 Hours

Reference(s)

1. Ramez Gayed, Amin Ghali, Structural Analysis Fundamentals Published September 17, 2021
2. SS Bhavikatti, Structural Analysis,Third edition, Volume I Second Edition Volume II, Vikas Publishing House(p)ltd ,2018
3. Vaidyanathan.R, Perumal.P, Comprehensive Structural Analysis, Vol I & II Laxmi Publications, 2018
4. James Hanson, Structural Analysis: Skills for Practice, Tata McGraw Hill publishing company limited,2022.

22CE603 DESIGN OF STEEL STRUCTURES 3 0 2 4

Course Objectives

- To impart knowledge on Limit State Design Methods for steel Structures.
- To impart knowledge on the codal provisions for the design of steel structures.
- To impart knowledge on the design of connections, tension members, compression members, beams and rooftrusses.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Apply the codal provisions to design bolted and welded connections.
2. Apply the codal requirements to design tension members, splices, lug angles and gussets.
3. Design compression members, Lacings, Battens and column base by applying the codal recommendations.
4. Design laterally supported beams, unsupported beams and plate girders by applying the codal references.
5. Apply the codal provisions to design the steel roof truss and gantry girder.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										1	1
2	3	2	1										1	1
3	3	2	1										1	1
4	3	2	1										1	1
5	1	1	1										2	1

UNIT I **9 Hours**

INTRODUCTION

Introduction to steel structures - Use of relevant Indian standard codes - Comparison of Working stress and Limit state method of design - Properties of steel - Structural steel sections - Types of connections - Codal provisions for connections - Design of bolted and welded connections for axial load - Efficiency of joint. Introduction to eccentric connections.

UNIT II

9 Hours

TENSION MEMBERS

Introduction to types of Tension Members - Failure of tension member - Codal provisions for tension members - Design of tension members with its end connections - Design of tension splices, Lug Angles and Gussets.

UNIT III **9 Hours**

COMPRESSION MEMBERS

Introduction to types of compression members - Theory of column: Loads on compression member - Failuremodes of an axially loaded column - Influence of Effective length and slenderness ratio on the strength of

column - Codal provisions for compression members - Design of Compression Members - Design of lacingsand battens - Design of column base: Slab Base - Gusseted Base.

UNIT IV **9 Hours**

DESIGN OF BEAMS

Introduction to design of flexural members - Web crippling - Web buckling - Design of laterally supported and unsupported beams. Plate Girder: Introduction - Parts of plate girder - Design of plate girders - Intermediate and bearing stiffeners.

UNIT V **9 Hours**

GANTRY GIRDER AND ROOF TRUSS

Gantry Girder Introduction Components Loads on gantry girder Design of gantry girder Steel Roof Truss Types of steel truss Components Gravity and Wind loads on purlin and rafter - Design of roof trusses and purlins.

EXPERIMENT 1 **5 Hours**

Design and detailing of bolted joints using software.

EXPERIMENT 2 **5 Hours**

Design and detailing of welded joints using software.

EXPERIMENT 3 **5 Hours**

Design and detailing of tension members using software.

EXPERIMENT 4 **5 Hours**

Design and detailing of compression members using software.

EXPERIMENT 5 **5 Hours**

Design and detailing of purlin using software.

EXPERIMENT 6 **5 Hours**

Design and detailing of roof truss using software.

Total: 75 hours

Reference(s)

1. N. Subramanian, Design of Steel Structures, Oxford University Press 2011.
2. S. K. Duggal, Limit State Design of Steel Structures, Tata, McGraw Hill Education Pvt Ltd, New Delhi, 2014.
3. M. R. Shiyekar, Limit State Design in Structural Steel, PHI Learning Private Limited, New Delhi, 2013.
4. S.S.Bhavikatti, Design of Steel Structures, I. K. International Publishing House Pvt. Ltd., Fifth edition, 2017.
5. K. S. Sai Ram, Design of Steel Structures, Dorling Kindersley (India) Pvt. Ltd, Pearson Education in South Asia.
6. IS 800 - 2007, IS 800 - 1984 General Construction in Steel - Code of Practice, BIS, New Delhi.

22CE607 MINI PROJECT II **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find thesolution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and anengineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, suchas, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 Recognize the need for, and have the preparation and ability to engage in independentand life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement, and develop the designsolutions.
2. Identify technical ideas, strategies, and methodologies.
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solutionof the project.
4. Test and validate through conformance of the developed prototype and analysis of thecost- effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2	1	1	1	1
2		-	1	1	2			2	2	2	1	1	1	1
3	-		1	1	2			2	2	2	1	1	1	1
4	-		1	1	2			2	2	2	1	1	1	1
5	-	-	-		2			2	2	2	1	1	1	1

22CE701 HIGHWAY AND RAILWAY ENGINEERING 3 0 0 3

Course Objectives

- To provide a basic knowledge on highway planning and highway materials
- To impart a basic knowledge on geometric design and design of pavements
- To provide a basic knowledge on railway planning, design and construction

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineeringpractice.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the concepts of highway alignment and the highway proposal
2. Design various cross sectional elements of highway and construction of flexible and rigidpavementsas per the standards of Indian Road Congress (IRC)
3. Analyze the construction and maintenance of highways
4. Identify the basic components of railway track.
5. Characterize the techniques used in construction and maintenance of railway track

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1			1		1				1		
2	3	2	1			1		1						2
3	1	3	2					2					1	
4	1	3	1	2	2	1		2				1		1
5	2	1		1	1			2				1		2

UNIT I **9 Hours**

HIGHWAY PLANNING AND ALIGNMENT

Introduction to highway - Institutions for highway planning and implementation at different levels - Jayakar committee recommendations - Requirements of ideal alignment - Factors controlling highway alignment -Engineering surveys for alignment - Conventional methods and modern methods (Remote Sensing, GIS and GPS techniques) - Highway cross sectional elements - Right of Way, carriage way, camber, kerbs, shoulders and footpaths [IRC Standards].

UNIT II **9 Hours**

GEOMETRIC DESIGN OF HIGHWAYS

Design of horizontal alignments: Super elevation, Widening of pavements on horizontal curves and transition curves [Problems]. Design of vertical alignments - gradients, summit and valley curves - Sight distances: Factors affecting sight distances, PIEV Theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), [Problems in SSD and OSD] - Geometric design of hill roads [IRC Standards Only] - Design principles of flexible and rigid pavements (IRC Recommendations - Problems)

UNIT III **9 Hours**

HIGHWAY CONSTRUCTION AND MAINTENANCE

Construction of WBM, bituminous concrete roads and cement concrete roads - Desirable Properties and Testing of Highway Materials-Soil: California Bearing Ratio Test - Aggregate: Crushing, Abrasion and Impact Tests - Bitumen: Penetration, Ductility, Viscosity, Binder Content and Softening Point Tests - Types of defects in flexible pavements and rigid pavements - Overlays - - Benkelman beam method - Roadside development and Arboriculture.

UNIT IV **9 Hours**

RAILWAY PLANNING AND DESIGN

Introduction - Engineering survey for track alignment- Permanent Way - Components andfunctions of each component - Gauges in railway tracks - Coning of wheels- Creeps and kinks - Geometric design of railway tracks -Gradient - Super-Elevation - Widening of gauges in curves

UNIT V **9 Hours**

RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND OPERATION

Track construction and maintenance - Track drainage - Lay outs of railway stations and yards - Points and Crossings - Signals - Types of signals - Principles and mechanism of interlocking - Methods of interlocking - Track circuiting - Electric traction - Introduction to modern trends in Indian Railways in the design of high speed tracks - Track Modernization - Automated maintenance and upgrading.

Total: 45 Hours

Reference(s)

1. S. K. Khanna ,C. E. G. Justo, A.Veeraraghavan, Highway Engineering, NemChand andBros.,Roorkee, 2015 (tenth edition) ISBN 978-81-85240-80
2. K. P. Subramaniam, Highway, Railway, Airport and Harbour Engineering,ScitechPublications,Chennai, 2011, ISBN-13: 978-8183712712
3. IRC 37 - 2012, Guidelines for the Design of Flexible Pavements
4. S. C. Saxena and S. P. Arora, Railway Engineering, Dhanapat Rai PublicationsPvt. Ltd., NewDelhi,2010.
5. L. R. Kadiyali, Principles and Practice of Highway Engineering, Khanna Publishers Ltd.,NewDelhi, 2017.ISBN No.978-81-7409-220-X

21CE702 ESTIMATION, COSTING AND QUANTITYSURVEYING 3 1 0 4

Course Objectives

- To impart fundamental knowledge on investigation of the site and selection of suitable foundation.
- To make the students understand the methods of estimating the cost of buildings.
- To know about the rate analysis and bill preparations.
- To study about the specification writing.
- To understand the valuation of land and buildings.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineeringpractice.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Perform the unit quantities for different materials.
2. Identify the types of estimates for analyzing the cost estimation of a building.
3. Carry out analysis of rates and bill preparation at different buildings.
4. Demonstrate the concepts of specification writing for tenders.
5. Estimate the total cost of construction and plan of building for carry out valuation of assets.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	-	-	-		-				1	1	
2	3	3	3	2								1		2
3	3	3	-	2		1						1	1	2
4	3			3	1	-						1		2
5		3		3				3				1	1	

UNIT I **9 Hours**

BASICS OF ESTIMATION

General items of work in Building - Earthwork - Cement Concrete work - R.C.C. work - Stonework - Brickwork - Wood work - Ironwork - Flooring - Finishing Work Standard units - Principles of working out quantities for detailed and abstract estimates - An approximate method of Estimating - Detailed Estimates of Buildings.

UNIT II **9 Hours**

COST ESTIMATION OF QUANTITIES OF MATERIALS

Earthwork excavation - Sand filling - Lime concrete - Cement concrete - R.C.C work - Cement mortar - Brickwork - Reinforced brickwork - Stone masonry - Plastering - Painting - Flooring - White and colour washing - Distempering - Varnishing - Woodwork - Centering - Shuttering and formwork for R.C.C works - Bar bending details of RCC Elements of such as beam - Column - Slab and foundation - AC sheet roofing, etc.

UNIT III **9 Hours**

ESTIMATION OF BUILDINGS

Load bearing and framed structures - Calculation of quantities of brickwork, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof - Estimating of a septic tank and soak pit - Steel structures with flat and pitched roof.

UNIT IV **9 Hours**

SPECIFICATION AND TENDERS

Data - Schedule of rates - Analysis of rates - Specifications - Sources - Preparation of detailed and general specifications - Tenders - Tamilnadu Tender Transparency Act - e-tender - Preparation of Tender Notice and Document - Contracts - Types of contracts - Drafting of contract documents - Arbitration and legal requirements.

UNIT V **9 Hours**

VALUATION

Valuation: Purpose of valuation, types of property - Depreciation, sinking fund, Leasehold and freehold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and year's purchase - Rental method of valuations - Typical problems.

Total: 45+15=60 Hours

Reference(s)

1. B.N. Dutta, & Estimating and Costing in Civil Engineering & Theory and Practice Including Specifications and Valuations, 28th edition; CBS Publishers & Distributors Pvt Ltd., 2020.
2. Kohli, D.D and Kohli, R.C., & A Text Book of Estimating and Costing (Civil) & S. Chand& Company Ltd., 2004.
3. Gurcharan Singh and Jagdish Singh & A Text Book of Estimating, Costing and Valuation&Standard Publishers Distributors, Delhi, 1998.
4. K. S. Randwala and K.K. Rangwala & Elements of Estimating and Costing & Chavotar PublishingHouse, India, 1995.

22CE707 PROJECT WORK I **0 0 4 2**

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significantscope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realisticdesign time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with thespecifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, andgraphical form.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization tothe solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9 Function effectively as an individual, and as a member or leader in diverse teams, andin multidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of theproject.
4. Test and validate through conformance of the designed building and estimating the totalcost.
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2			2	2	2			1	1	1
2	1	2	1	1	2			2	2	2			1	1	1
3	1	2	1	1	2			2	2	2	2		1	1	1
4	1	2	1	1	2			2	2	2	2		1	1	1
5	1	2			2			2	2	2			1	1	1

22CE801 PROJECT WORK II 0 0 4 2

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended designproblem of significantscope, depth, and breadth
- Understand and incorporate engineering standards and multiple realistic constraints,within realistic designtime, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with thespecifications.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3 Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of theproject.
4. Test and validate through conformance of the designed building and estimating the totalcost.
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2			2	2	2			1	1	1
2	1	2	1	1	2			2	2	2			1	1	1
3	1	2	1	1	2			2	2	2	2		1	1	1
4	1	2	1	1	2			2	2	2	2		1	1	1
5	1	2			2			2	2	2			1	1	1

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

CourseObjectives

- Commandover theEnglishlanguageforday-to-daytransactions.
- Improvelisteningand readingskills tocomprehendcomplexcontent
- Enhanceconfidenceinexpressingwith clarityand elegance with enthusiasticandreflectiveuseofthelanguage

Programme Outcomes (POs)

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CourseOutcomes(COs)

1. EngagewiththeEnglishlanguageinfunctionalcontexts
2. Expressinbothdescriptiveandnarrativeformats
3. UnderstandandmakeeffectiveuseoftheEnglishLanguageinBusiness contexts
4. Activelyreadandcomprehendauthentictext
5. Expressopinionsandcommunicateexperiences.

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3		3		
2									3	3		3		
3									3	3		3		
4									3	3		3		
5									3	3		3		

UNIT I 15Hours

SELF-EXPRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and Weaknesses-Abstract nouns -Adjectives-Active Listening Skills-Note Making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional Ethics-Reported Speech- Conjunctions Readingskills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses- Hypothetical questions and Answers-Sentence Structure-Simple Present Tense-Perfect tense

UNIT II 15Hours

CREATIVEEXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept Explanation-Reported Speech-Voice Sentence Equivalence-Proofreading

UNIT III **15Hours**

FORMALEXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and Found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences,calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and Articles-Spelling-Reading: Analyzing and interpreting notices and Circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

Total:45 Hours

Reference(s)

1. Sasikumar,V,et.al.A Course in Listening & Speaking Foundation Books,2005.
2. Murphy,Raymond. English Grammar inUse:ASelf- StudyReferenceandPracticeBookforIntermediateStudents: withAnswers.Cambridge:CambridgeUniversityPress,1985.
3. Prasad,Hari Mohan.A Handbook of Spotting Errors.McgrawHill Education,2010.
4. Reynolds, John. Cambridge First LanguageEnglish.2018thed.,Hodder Education,2018.
5. Wiggins, GrantP.,andJayMcTighe.Understanding by Design.Association for Supervision and CurriculumDevelopment, 2008.

22HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

Program Outcomes

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

VOWELS AND CONSONANTS

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises

UNIT III **9 Hours**

PRONOUNS AND TENSES

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes -Directions - Seasons Professions.

UNIT V **9 Hours**

CONVERSATIONS

Speaking - Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd.,New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

22HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Program Outcomes

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. use basic phonemes and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working withDictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention topronunciation

UNIT III **9 Hours**

TECHNICAL DEUTSCHE

Regular &Irregular verbs -Personal pronouns-family-Introduction to types of sentences

UNIT IV **9 Hours**

INTERROGATION

Question words -Types of Questions -Nominative case-Verb Conjugation -country -nationalities

UNIT V **9 Hours**

IMPLEMENTATION

Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers& Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & DistributersPvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

Program Outcomes

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions -Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information

UNIT III **9 Hours**

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation

Listening to Japanese Alphabet Pronunciation -Simple Conversation

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu - Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to differentCounters, simple conversations with verbs and adjectives

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Program Outcomes

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3		-		

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, lespieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie - Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait Communication Propose

a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires.

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, l argent.

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

22CE001 REPAIR AND REHABILITATION OF STRUCTURES

3 0 0 3

Course Objectives

- To emphasize the importance of maintenance and in section of structures.
- To impart fundamental knowledge on various repairing strategies.
- To interpret the results of non-destructive testing (NDT) and other diagnostic tools.

Programme Outcomes (POs)

PO3 Design solutions for complex engineering problems and design system components or processes that meet thespecified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Diagnosis and assessment procedure for the distress structures.
2. Investigate the Corrosion factors and control methods
3. Identify the Serviceability and Durability of Concrete Structures.
4. Infer the suitable repair materials and its application
5. Identify the techniques for repair and demolition of distressed structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			-		2	3	-					1	1	1
2			2		2	3	-					2	1	1
3			-		1	2	3					1	1	1
4						2	3					3	1	1
5			-		1		2					2	1	1

UNIT I **9 Hours**

MAINTENANCE AND REPAIR STRATEGIES

Maintenance, repair and rehabilitation - Facets of maintenance - Importance of maintenance - Causes ofdeterioration - Inspection - Preventive measures - Assessment procedure for evaluating damaged structure.

UNIT II **9 Hours**

CORROSION PROTECTION

Corrosion mechanism - Corrosion damage of reinforced concrete - Causes, Effects and Remedial measures - Methods of corrosion protection - Design and construction errors - Effects of cover thickness - Corrosion inhibitors - Corrosion resistant steels - Coatings - Cathodic protection - Deterioration of concrete, steel, masonry and timber structures - Surface deterioration and efflorescence - Preventive measures.

UNIT III **9 Hours**

SERVICEABILITY AND DURABILITY OF CONCRETE STRUCTURES

Durability of concrete in seawater - Thermal properties of concrete - Fire resistance - Resistance to freezing and thawing - Permeability of concrete - Sulphate attack - Methods of control - Quality assurance – Conceptual bases for quality assurance schemes.

UNIT IV **9 Hours**

MATERIALS AND TECHNIQUES FOR REPAIR

Special concrete and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fiber reinforced concrete.

UNIT V **9 Hours**

TECHNIQUES FOR REPAIR AND DEMOLITION

Rust eliminators and polymers coating for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning - Engineered demolition techniques for dilapidated structures - Case studies.

Total: 45 Hours

Reference(s)

1. Raiker .R.N,"Learning from Failures, Deficiencies in Design, Construction and Service, - R&DCentre (SDCPL), Raikar Bhavan, Bombay 2017.
2. Repair & Rehabilitation, Compilation from The Indian Concrete Journal,ACC-RCD Publication 2016.
3. Allen .R.T, and Edwards.S.C, Shaw D.N Repair of Concrete Structures, Chapman and Hall,2015.
4. M.S.Shetty, Concrete Technology Theory and Practice, S.Chand & Co., NewDelhi, 2022.
5. Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair,Longman Scientific and Technical Publications, UK, 2016.
6. Peter H.Emmons, Concrete Repair and Maintenance Illustrated Problem Analysis, Repair Strategy, Techniques, Galgotia Publication, 2018.

22CE002 PRESTRESSED CONCRETE STRUCTURES 3 0 0 3

Course Objectives

- Interpret the basic concept of pre-stress concrete, materials, methods and factors influencing pre-stress.
- Implement the basic assumptions of elastic analysis and design pre-stressed flexural and shearmembers
- Predict the stresses due to long term and short term deflection and design a pre-stress member accordingly

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, andenvironmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze the stresses in pre-stressed concrete member due to pre-stressing force and its variation dueto losses.
2. Design the layout of cables for Type I and Type II beams based on calculation of moment of resistance.
3. Compute the deflections and anchorage zone stresses.
4. Implement the methods for achieving continuity in beams.
5. Evaluate the design of circular pre-stressing and the uses of non-prestressed reinforcement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2									1	1	1
2	1	2	3									1		
3	1	2	3									1		
4	2	1	3									1		
5	1	2	3											

UNIT I **9 Hours**

INTRODUCTION

Principles of Prestressing - Classification and types - Advantages over reinforced concrete - Materials - Highstrength concrete and high tensile steel - Methods of Prestressing - Freyssinet, Magnel Blaton, Lee Mc Call and Killick anchorage systems - Analysis of sections for stresses by stress concept, strength concept and loadbalancing concept - Losses of prestress.

UNIT II **9 Hours**

DESIGN FOR FLEXURE AND SHEAR

Basic assumptions for calculating flexural stresses - Permissible stresses in steel and concrete as per IS 1343 Code - Design of sections of Type I and Type II post -tensioned and pre -tensioned beams - Check for strengthlimit state based on IS 1343 Code - Layout of cables in post-tensioned beams - Location of wires in pre- tensioned beams - Design for shear based on IS 1343 Code.

UNIT III **9 Hours**

DEFLECTION AND DESIGN OF ANCHORAGE ZONE

Factors influencing deflections - Short term deflections of uncracked members - Prediction of long term deflections due to creep and shrinkage - Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel"s method, Guyon"s method and IS 1343 code - Design of anchorage zone reinforcement.

UNIT IV **9 Hours**

COMPOSITE BEAMS AND CONTINUOUS BEAMS

Types of R.C.C - P.S.C composite beams - Analysis and design of composite beams and Continuous Beams -Methods of achieving Continuity in continuous beams - Concordant cable and linear transformation - Calculation of stresses - Principles of design.

UNIT V **9 Hours**

MISCELLANEOUS STRUCTURES

Design of compression members and tension members - Circular prestressing - Water tanks - Pipes - Analysisand design - IS Codal provisions.

Total: 45 Hours

Reference(s)

1. Krishna Raju, N., "Prestressed Concrete", Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Lin, T.Y. and Ned. H. Burns, "Design of Prestressed Concrete Structures", John Wiley & Sons, NewYork, 2009.
3. Rajagopalan, N., "Prestressed Concrete", Narosa Publishing House, New Delhi,2008.
4. IS 1343 - 2012: Code of practice for Prestressed concrete.
5. IS 784 - 2001: Code of practice for Prestressed concrete pipes.
6. IS 3370 - 1999: Code of practice for concrete structures for the storage of liquids.

22CE003 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

3 0 0 3

Course Objectives

- To impart knowledge on the theory of vibration and basics of structural dynamics.
- To impart the design philosophy of earthquake resistant design of structures.
- To create awareness on the use of codal provisions for aseismic design of structures.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Infer the concept of equation of motion for a single degree of freedom system.
2. Illustrate the characteristics of earthquakes and its effects.
3. Analysis of the RC building by Equivalent static analysis.
4. Illustrate the various seismic resistant methods and its ductile detailing for RC and masonry structures.
5. Identify the Retrofitting techniques for RC buildings and its structural elements.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	-	-	-								
2	1	-			2	3								
3		2	3		1								1	1
4	-	3	2	-	1	-								
5	-	1		2	3		2							

UNIT I **9 Hours**

PRINCIPLES OF DYNAMICS

Vibration studies - Elements of vibratory systems and simple harmonic motion - Vibration with and without damping - D"Alembert"s principle - Degree of freedom: Equation of motion for S.D.O.F - Damped and undamped free forced vibrations.

9 Hours

UNIT II

INTRODUCTION TO EARTHQUAKE ENGINEERING

Elements of engineering seismology - Causes of earthquakes - Seismic waves - Magnitude - Intensity and Energy release - Indian seismology - Earthquake history - Catastrophes - Failures - Lessons learnt from past earthquakes - Seismic zone map of India - Estimation of Earthquake Parameters, Microzonation - Strong ground motion characteristics.

UNIT III **9 Hours**

SEISMIC DESIGN OF BUILDINGS

Idealization of building frames - Methods of seismic analysis - Equivalent static analysis - IS 1893 provisions - Design horizontal seismic coefficient - Design base shear distribution - Seismic resistant design of buildings

UNIT IV **9 Hours**

EARTHQUAKE RESISTANT STRUCTURES

Earthquake resistant properties of materials - Lateral force resisting systems - Strong column weak beam - Guidelines for seismic-resistant construction - Building configuration requirements - Ductile detailing of reinforcements in RC buildings - Behavior masonry structures - Behaviour of tall buildings under seismic andwind conditions.

UNIT V **9 Hours**

REPAIRS AND RETROFITTING

Code of practices for repairs and retrofitting - Retrofitting of RC buildings and structural elements - Techniques of retrofitting - Improving structural integrity of masonry buildings - Tuned Mass Dampers - Retrofitting by seismic isolation - Case studies.

Total: 45 Hours

Reference(s)

1. Mario Paz, Structural Dynamics - Theory and Computation, CBS Publications, 2004.
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall ofIndia, 2006.
3. IS 1893 - 2002, Criteria for Earthquake Resistant Design of Structures.
4. IS 4326 - 1993, Earthquake Resistant Design and Construction of Buildings - Code of Practice.
5. IS 13920 - 1993, Ductile Detailing of Reinforced Concrete Structures to Seismic Forces - Code ofPractice.
6. IS 13935 - 1993, Repair and Seismic Strengthening of Buildings Guidelines.

22CE004 BRIDGE ENGINEERING **3 0 0 3**

Course Objectives

- To learn the components, classification and importance of bridges.
- To familiarize students about prefabrication, erection methods, and the use of innovative materials.in bridge construction.
- To know about the software tools and technologies used in bridge design and analysis.

Programme Outcomes (POs)

PO1Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations. PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. To be familiar with the components of bridges, classification of bridges, importance of bridges.
2. To identify the specification of road bridges, loads to be considered.
3. To be familiar with various types of bridges such as slab-bridge, T-beam bridge, pre-stressed concretebridge, continuous bridge, arch bridge, box girder bridge decks.
4. To analysis the various bridges-piers and abutments.
5. To get exposed to evaluation of sub structures, type of foundations, importance of bearings, lessonsfrom bridge failures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		-	-	3							1	1
2	1			2		3							1	1
3	1	2											1	1
4	1	2		3									1	1
5	1			2	3								1	1

UNIT I **9 Hours**

INTRODUCTION

Components of Bridges - Classification - Importance of Bridges - Investigation for Bridges - Selection of Bridge site - Economical span - Location of piers and abutments - Subsoil exploration - Scour depth - Trafficprojection - Choice of bridge type

UNIT II **9 Hours**

SPECIFICATION OF BRIDGES

Specification of road bridges - width of carriageway - loads to be considered - dead load - IRC standard live load - Impact effect.

UNIT III **9 Hours**

DESIGN OF BRIDGES

General design considerations - Slab Bridge - Design of T-beam bridge - Prestressed concrete bridge - continuous bridge - Arch Bridge - Box girder bridge decks.

UNIT IV **9 Hours**

ANALYSIS OF BRIDGES

Evaluation of sub structures - Pier and abutments caps - Design of pier - Abutments - Type of foundations.

UNIT V **9 Hours**

BEARING AND JOINTS OF BRIDGES

Importance of Bearings - Bearings for slab bridges - Bearings for girder bridges - Electrometric bearing -Joints - Expansion joints. Construction and Maintenance of bridges - Lessons from bridge failures.

Total: 45 Hours

Reference(s)

1. Ponnuswamy, S., Bridge Engineering, Tata McGraw-Hill, New Delhi, 1997.
2. Victor, D. J., Essentials of Bridge Engineering, Oxford and IBH Publishers Co., New Delhi, 1980.
3. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.
4. Jagadeesh. T. R. and Jayaram. M. A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd.,2004.
5. Raina. V. K., Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1991

22CE005 TALL STRUCTURES 3 0 0 3

Course Objectives

- To provide students with a comprehensive understanding and concepts related to the design and construction of tall structures
- To equip students with the skills to analyze the structural behavior of tall buildings under various loads andconditions
- To introduce students to the software tools and technologies used in the design and analysis of tall structures, including finite element analysis and building information modelling (BIM).

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto thesolution of complex engineering problems.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range ofCivil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Design the tall building based on different load conditions
2. Analyze the shear wall and load bearing wall panel systems
3. Comparison of Composite Buildings and High Rise Structural Systems
4. Design and analysis of Composite Buildings and High Rise Structural Systems
5. Analyze of High Rise Suspension Systems and Pneumatic High Rise Buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2												1	1
2	1												1	1
3	1												1	1
4	2												1	1
5	2												1	1

UNIT I **9 Hours**

INTRODUCTION

Tall Building in the Urban Context -Tall Building and its Support Structure -Development of High Rise Building Structures - General Planning Considerations.Dead Loads - Live Loads-Construction Loads - Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading, Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads - Combination of Loads.

UNIT II **9 Hours**

THE VERTICAL STRUCTURE PLANE

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

UNIT III **9 Hours**

COMMON HIGH-RISE BUILDING STRUCTURES AND THEIR BEHAVIOUR UNDER LOAD

Bearing Wall Structure-Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatialand Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - The Counteracting Force or Dynamic Response.

UNIT IV **9 Hours**

APPROXIMATE STRUCTURAL ANALYSIS AND DESIGN OF BUILDINGS

Approximate Analysis of Bearing Wall Buildings -Cross Wall Structure -Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings Rigid Frame - Shear Wall Structure - Vierendeel Structure - Hollow Tube Structure.

UNIT V **9 Hours**

ADVANCES IN RAILWAYS

Introduction to modern trends in Indian Railways in the design of high speed tracks - Modern trends in railwaytrackalignment - Railways for Urban area - LRT & MRTS - Mono Rail - Metro Rail - Hyper loop- Recent developments in railway projects.

Total: 45 Hours

Reference(s)

1. WOLFGANG SCHUELLER " High - rise building Structures", John Wiley and Sons Bryan StaffordSmith and Alex Coull, " Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc.,

22CE006 STRUCTURAL HEALTH MONITORING **3 0 0 3**

Course Objectives

- To introduce the concepts involved in the assessment, evaluation and technical diagnosis of different structural systems of strategic importance
- To impart knowledge on both elementary and advanced applications of SHM with case studies
- To familiarize students with the different components of SHM systems, including sensors, data acquisitionsystems, communication networks, and data processing techniques

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Recall basic concepts and need for Structural Health monitoring
2. Analyze static and dynamic properties of materials using SHM methods
3. Analyze the damage prediction in different materials using NDT
4. Understand the application of sensors in SHM methods
5. Apply the SHM techniques in different types of structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-									1	1	1
2	1	2	-									1	1	1
3	-	2	1									1	1	1
4	1	2	3									1	1	1
5		2	1									1	1	1

UNIT I **9 Hours**

INTRODUCTION TO STRUCTURAL HEALTH MONITORING

Introduction -Necessity -Components -Challenges -Advantages - Components of SHM process -SHM issuesapplied to concrete structures -Level of uncertainties in SHM process

UNIT II **9 Hours**

STRUCTURAL HEALTH MONITORING METHODS

Short term and Long term Monitoring -Local and Global Monitoring -Static and Vibration based SHM - SHMplanning and Management - SHM Methods

UNIT III **9 Hours**

DAMAGE IDENTIFICATION METHODS

Damage Identification -Visual Inspection -Comparison of damage identification methods -Non Destructivetesting and Evaluation-Vibration based damage detection

UNIT IV **9 Hours**

SENSOR NETWORKING

Sensor Technologies -Fibre optic sensors -Smart Sensing for SHM -Sensing requirements in special structures - Sensor requirements and Data Acquisition -Acquisition system and Networking for SHM - Wireless Sensor Networking -MEMS-Artificial Intelligence in SHM

UNIT V **9 Hours**

APPLICATIONS OF SHM

SHM layout design of offshore structures -SHM Design -Application of SHM in bridges, buildings andoffshore structures - Application in structural control strategies -Future of SHM

Total: 45 Hours

Reference(s)

1. Balageas, D., Fritzen, C.P. and Gemes, A. eds., 2010. Structural health monitoring (Vol. 90). JohnWiley & Sons.
2. Chandrasekaran, S. 2016. Offshore structural engineering: Reliability and Risk Assessment, CRCPress, Florida, ISBN:978-14-987-6519-0.
3. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures, Springer, 2nd Ed., Singapore.Do, R., 2014.
4. Passive and active sensing technologies for structural health monitoring. University of California, SanDiego.
5. Glisic, B. and Inaudi, D., 2008. Fibre optic methods for structural health monitoring. John Wiley & Sons.Nagayama, T. and Spencer Jr, B.F., 2007. Structural health monitoring using smart sensors. NewmarkStructuralEngineering Laboratory. University of Illinois at Urbana

22CE007 DESIGN OF TIMBER AND MASONRY ELEMENTS

3 0 0 3

Course Objectives

- To impart basic knowledge on the application and maintenance of timber structures.
- To outline the design aspects of timber and masonry structures.
- To illustrate the need of timber and masonry structures.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the suitable structural materials and different load conditions. Identify the suitable structuralmaterials and different load conditions
2. Evaluate the design consideration of various timber elements.
3. Analysis and design of masonry columns for axial and eccentric loading conditions
4. Design of different types of masonry walls.
5. Explain the types and manufacturing process of concrete block walls.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-				1					1	1	1
2	3	2	-				-					1	1	1
3	3	1	3	1								2	1	1
4	3	3	2				-					2	-	-
5	3	2	2									3	-	-

UNIT I **9 Hours**

CONCEPTS OF TIMBER STRUCTURES

Factors affecting strength of timber - Permissible stresses - Bearing stress -Types of loads - Dead load - Live load - Wind load - earthquake load - Load Calculation for design as per codal provisions - Choice between different structural materials - Masonry, timber, concrete and steel - Maintenance of Timber Structure.

UNIT II **9 Hours**

DESIGN OF TIMBER STRUCTURES

Design of beams for strength and stiffness as per BIS code - Design of rectangular beams - Design of tensionmembers - Design of compression members of solid and box sections - Types of joints with nails and bolts - Design of bolted and nailed connections - Design of timber joists - Allowable stresses in tension, compressionand flexure.

UNIT III **9 Hours**

DESIGN OF BRICK MASONRY COLUMN

Mix proportions - Compressive strength of mortars - Shape factor for masonry units - Stability of piers and walls - Design as per IS Codes - Design of permissible compressive stresses in masonry - Design of masonrycolumn subjected to axial and eccentric loading.

UNIT IV **9 Hours**

DESIGN OF MASONRY WALL

Types of walls - Design of solid load bearing wall for axial loads - Design of solid load bearing wall for eccentric loads - Design of wall with opening - Design of cavity wall - Design of stiffened and unstiffened wall.

UNIT V **9 Hours**

DESIGN OF CONCRETE BLOCK MASONRY

Concrete blocks - Lightweight blocks - AAC Blocks - Hollow Blocks as per IS 2185 - Manufacturing of Hollow Blocks - Tests on Hollow Blocks - Design and Construction of Hollow Block Masonry Walls.

Total: 45 Hours

Reference(s)

1. A.S. Arya, Design of Masonry and Timber Structures, Nemchand and Bros. Publishing, 2007.
2. P. Dayaratnam, Brick and Reinforced Brick Structures, Oxford & IBH Publishing Co. Pvt. Ltd, 1997.
3. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Design of steel structures, Laxmi Publications (P) Ltd, 2007.
4. W. M. C McKenzie, Design of Structural Elements, Macmillan Publishers, 2010.
5. IS: 1905 - 1980, Indian Standard Code of Practice for Structural Safety of Buildings, Masonry Walls,Indian Standards Institution, 1981.
6. IS: 883 - 1994, Code of Practice for Design of Structural Timber in Buildings, BIS New Delhi.

22CE008 ADVANCED RC DESIGN 3 0 0 3

Course Objectives

- To impart knowledge on the limit state design of RC Structural components
- To enhance the confidence level of students to design the special structural elements as per Indianstandard code of practices.
- To introduce students to the design and analysis of prestressed concrete elements, covering bothpre-tensioning and post-tensioning techniques.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, andenvironmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Design and detailing of special RC elements
2. Analysis of RC slab using yield line theory and design of flat slab and grid floor
3. Design of RC beam for serviceability conditions and design of column as per IS 456
4. Design of RC walls and concepts of ductile detailing
5. Evaluate the RC section with moment redistribution and ultimate load analysis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	1	-							3	1	1
2	2	2		2	1							2	1	1
3	1	1	1	1	-							1	1	1
4	2	2	1	-	-							1	2	2
5	1	1	1	1									-	-

UNIT I **9 Hours**

SPECIAL STRUCTURAL MEMBERS

Design of RC beams: continuous beams, Curved beams and Deep beams - Design of Corbels.

UNIT II **9 Hours**

DESIGN OF SLABS AND YIELD LINE THEORY

Assumptions - Yield line patterns for various types of slabs with different boundary conditions - Yield line theory of slabs - Virtual work method - Equilibrium methods - Hillerborg method of design. Design of flat slabs - Design of grid floors as per I.S.456.

UNIT III **9 Hours**

LIMIT SATATE OF SERVICEABILITY

Parameters considered in limit state of serviceability - Short term deflection - long term deflection - Calculation of deflections in beams under working loads - Calculation of crack width in beams

UNIT IV **9 Hours**

DESIGN OF RC WALL AND DUCTILE DETAILING

Design of RC walls - Shear walls. Concepts of ductility- Factors influencing ductility - Design principles and codal provisions.

UNIT V **9 Hours**

ULTIMATE LOAD ANALYSIS AND INELASTIC BEHAVIOUR

Whitney""s theory - Ultimate load analysis - Moment redistribution and moment rotation characteristics of a R.C. section - Plastic hinges check for rotation capacity of sections. Concept of moment - rotation curves.

Total: 45 Hours

Reference(s)

1. S. Unnikrishna Pillai and DevadosMenon, Reinforced Concrete Design, Tata McGraw Hill Education,2011
2. P.C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall International Edition, 2006
3. N. Krishnaraju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2000
4. R. Park and T. Paulay, Reinforced Concrete Structures, John Wiley Sons, 2008
5. Gambhir, M.L. Design of Reinforced Concrete Structures, Prentice Hall of India, 2012
6. S.N. Sinha, Handbook of Reinforced Concrete Design, Tata McGraw Hill Education, 2004

22CE009 ADVANCED STEEL DESIGN 3 0 0 3

Course Objectives

- To impart knowledge on the complex steel structures design
- To introduce the concept of cold formed steel design.
- To know the methodologies for designing advanced steel elements, including beams, columns, trusses,frames, and connections.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze and design structural components combined bending and axial load
2. Design plate girders and composite beams and its components
3. Compute the suitable section dimension of a gantry girder
4. Analyze and design roof truss and its components
5. Differentiate the cold formed steel and normal steel constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	1								1	1
2	3	3	1	1	1								1	1
3	3	3	1	1	1								1	1
4	3	3	1	1	1								2	2
5	3	2	1	2	1								1	1

UNIT I **9 Hours**

DESIGN OF BEAM-COLUMNS

Introduction to plate girder - Elements of plate girder - IS 800-2007 codal provisions Preliminary design considerations - concept of Tension field action - design of end panels. Design of plate girder using IS 800- 2007- Design of vertical stiffeners - design of longitudinal stiffeners - design of torsional stiffeners - Introduction to steel plate shear wall.

UNIT II **9 Hours**

DESIGN OF PLATE GIRDER

Introduction to plate girder - Elements of plate girder - IS 800-2007 codal provisions Preliminary design considerations - concept of Tension field action - design of end panels. Design of plate girder using IS 800- 2007- Design of vertical stiffeners - design of longitudinal stiffeners - design of torsional stiffeners - Introduction to steel plate shear wall.

UNIT III **9 Hours**

DESIGN OF PLATE GIRDER

Introduction - loading consideration - maximum load effect - Selection of Gantry girder - Design of gantrygirders for primary loads only

UNIT IV **9 Hours**

DESIGN OF INDUSTRIAL STRUCTURES

Introduction - analysis and design of truss members - Design of gable portal frame - analysis and design ofGantry girder columns - pre-engineered buildings - advantages and design principles

UNIT V **9 Hours**

COLD FORMED STEEL

Introduction - advantages of Cold formed steel sections - Types of Stiffened and Unstiffened Elements -local buckling - lateral buckling - empirical methods - z purlins - design rules

Total: 45 Hours

Reference(s)

1. J. Rhodes and R.M. Lawson "Design of Structures using Cold Formed Steel Sections, SCI Publication089, The Steel Construction Institute, U.K. 1992.
2. Limit State Design of Steel Structures S. K. Duggal, McGraw Hill Education Private Ltd. New Delhi.
3. Design of Steel Structures, K. S. Sairam, Pearson Education.
4. Design of Steel Structures, N. Subramanian, Oxford University Press.
5. Indian Standard Code IS 800-2007 General Construction in Steel- Code of Practice, Steel Tables.
6. Design Steel Structures Volume II, Dr. Ramachandra & Vivendra Gehlot, Scientific PublishersJournals Department

22CE010 INDUSTRIAL STRUCTURES 3 0 0 3

Course Objectives

- To impart knowledge on classification of industries and their functional requirements
- To familiarise the students on the design of silos, bunkers and chimneys
- To impart knowledge on the transmission structures

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. To impart knowledge on the transmission structures
2. Demonstrate the functional requirements for any industry
3. Design of industrial RC and steel structures
4. Design Foundation for industries
5. Analyze the materials in pre-engineered concept

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	-	-								1	1	1
2	-	2											1	1
3	1	1	3	2									2	2
4	-	1	3	2									1	1
5	1		-	2									1	1

UNIT I **9 Hours**

PLANNING

Classification of Industries and Industrial Structures -Specific requirements for Industries like Engineering,Textiles, Chemicals, steel and cement. Site layout and external facilities required

UNIT II **9 Hours**

FUNCTIONAL REQUIREMENTS

Natural and artificial lighting - Electrical wiring fixtures - Electrical installations - substations - Effluent disposal - Fire expanse and chutes - fire alarm, extinguishers and hydrants - Guidelines from factories act. Heating and Ventilation - Air conditioning

UNIT III **9 Hours**

INDUSTRIAL BUILDINGS

Design and detailing of bunkers, silos, chimneys, Gantry Girders-principles of folded plates and shell roofs

UNIT IV **9 Hours**

FOUNDATION FOR INDUSTRIAL STRUCTURES

Types of Machine Foundations and their design-Foundations for RC and steel chimneys

UNIT V **9 Hours**

PRE ENGINEERED BUILDINGS

Introduction-Advantages and Disadvantages-Primary and secondary structural elements-foundation- wall materials-metal roofing

Total: 45 Hours

Reference(s)

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2008
2. P. Dayaratnam, Deign of steel structures, A.H. Wheeler & Co., Ltd., Allahabad, 2008
3. IS :4998 (part 1)"Indian Standard Practice for Design of Reinforced Concrete Chimneys IS: 4995 (part1 and part 2)criteria for design of reinforced concrete bins for storage of granular and powdery materials IS: 3483 code of practice for noise Reduction in industrial buildings. IS: 6060 code of practice for daylighting of factory buildings SP32-1986, Hand book on Functional requirements of Industrial Buildings. 1995
4. Henn W, Buildings for Industry, Vol I & II, London Hill
5. S. N. Manokar, Tall Chimneys, Design and Construction, Tata McGraw Hill, 1986

22CE011 FINITE ELEMENT ANALYSIS 3 0 0 3

Course Objectives

- To impact basic knowledge on the various steps involved in finite element analysis
- To introduce various types of one - two - three - dimensional elements
- To apply FEA to structural analysis problems, including static, dynamic, and stability analyses of variousstructural components and systems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Recall basic concepts of Finite Element Analysis
2. Spot coordinates for various elements
3. Analyse Truss and beam members by Finite element Method
4. Analyse one and two dimensional members
5. Analyse the special parameters of the structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-									1	1	1
2	1	2	-									2	2	2
3	-	2	1									1	2	2
4	1	2	1									1	1	1
5	-	2	1									1	1	1

UNIT I **9 Hours**

INTRODUCTION

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity - Steps in Finite ElementAnalysis - Virtual Work and Variational Principle - Galerkin Method- Finite Element Method: DisplacementApproach - Stiffness Matrix and Boundary Conditions

UNIT II **9 Hours**

ELEMENT PROPERTIES

Natural Coordinates - Triangular Elements - Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements -Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional

UNIT III **9 Hours**

ANALYSIS OF STRUCTURES BY FEM

Stiffness of Truss Members - Analysis of Truss - Stiffness of Beam Members - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Analysis of Grids.

UNIT IV **9 Hours**

FEM FOR TWO AND THREE-DIMENSIONAL STRESS ANALYSIS

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements - Numerical Evaluation of ElementStiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 DimensionalElements

UNIT V **9 Hours**

OTHER APPLICATIONS OF FEM

Fluid flow analysis - vibration analysis - Eigen Values and Eigen Vectors used for fluid analysis in pipes -Elastic Stability analysis - Plate bending problem

Total: 45 Hours

Reference(s)

1. S.Rajasekaran, Finite Element methods in Engineering Design, Wheeler, 1993
2. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Element in Engineering, ThirdEdition, Prentice Hall, India, 2003
3. Krishnamoorthy C. S,"Finite Element Analysis Theory and Programming", Tata McGraw Hill Education, 1994
4. David V. Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2004
5. Reddy J.N., An Introduction to Finite Element Method, McGraw-Hill, Intl. Student Edition, 1985
6. Rao S.S, The Finite Element Method in Engineering, Pergaman Press, 2014

22CE012 STEEL CONCRETE COMPOSITE STRUCTURES

3 0 0 3

Course Objectives

- To develop an understanding of the behaviour and design procedure of steel - concrete compositeelements and structures.
- To provide students with a comprehensive understanding of the principles, concepts, and significance of steel-concrete composite structures in modern construction.
- To give an exposure on case studies related to steel-concrete composite construction

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the different types of steel-concrete composite structure and its connections
2. Design the composite beam and column
3. Apply the studs in Roofs and Slabs and predict the cracking pattern
4. Analyse the various bridges and design the economical one
5. Discuss about historical Steel concrete composite construction and seismic behaviour of the structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1										1	1
2	1	1	1										1	1
3	2												1	1
4	2	2	2										1	1
5	2	2	2										1	1

UNIT I **9 Hours**

INTRODUCTION

Introduction to steel concrete composite construction advantages Theory of composite structures Introductionto steel Concrete Steel sandwich construction shear connectors Types characteristics and applications.

UNIT II **9 Hours**

DESIGN OF COMPOSITE BEAMS AND SLABS

Elastic Behaviour of composite beams and slabs - Design of composite beams including shear connector -Design of studs - Partial shear - Concrete cracking - Practical considerations - Cost implications

UNIT III **9 Hours**

COMPOSITE COLUMNS AND TRUSSES

Composite columns Types Materials advantages method of design Composite Trusses AnalysisConfigurationStud shear connectors Design consideration Cost implications

UNIT IV **9 Hours**

COMPOSITE BRIDGES

Introduction - design of composite bridge deck - Composite box girder bridges - Behaviour of compositeboxgirder bridges - Design concepts

UNIT V **9 Hours**

CASE STUDIES

Case studies on steel - Concrete composite construction -Seismic behaviour of composite structures -Failureof Steel-Concrete composite components/Structure.

Total: 45 Hours

Reference(s)

1. R. P. Johnson, Composite Structures of Steel and Concrete: Beams, slab, columns andframes forbuildings, Wiley Blackwell Scientific Publications, UK, 2018.
2. D.J. Oehlers and M.A. Bradford, "Composite Steel and Concrete Structural Members",Fundamental behaviour, pergamon press, Oxford,1995.
3. G. W. Owens and P. Knowels, Steel Designers Manual, Steel Concrete Institute (UK),Oxford Blackwell Scientific Publications, 1992.
4. N. Krishna Raju, "Design of Bridges", Oxford & IBH Publishing Company Pvt. Ltd, New Delhi.Fourth edition 2015.
5. IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel and Concrete.
6. INSDAG Hand book on Composite Construction - Institute for Steel Development and GrowthPublishers, Calcutta

22CE013 BUILDING SERVICES 3 0 0 3

Course Objectives

- To understand how a building can be made comfortable and safe with the services designed andinstalled.
- To impart knowledge on basics of electrical wiring system.
- To recognize the importance of fire detection and protection.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze the features of service machineries required for a building.
2. Identify suitable electrical systems and accessories to be installed during the construction of abuilding.
3. Identify the principles of illumination and artificial light sources.
4. Describe the working principle of refrigerants and air conditioning systems.
5. Analyze the characteristics of fire safety equipment for different types of buildings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2									2	1	
2	3	2	1									1		2
3	3	3	2											
4	3	1	2									1	1	
5	1	2	3									2		2

UNIT I **9 Hours**

ELEVATORS AND CONVEYORS

Elevators - Lifts and Escalators - Special features required for physically handicapped and elderly people - Conveyors - Types of conveyors - Horizontal moving walkways - Design criteria, speed size, capacity, number.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS IN BUILDINGS

Basics of electricity - Single / Three phase supply - Motors and generators - Protective devices in electrical installations - Types of wires - Electrical wiring systems in domestic and commercial buildings – Electrical wiring layout for building - Earthing - Types of earthing - ISI specifications - Main and distribution boards - Substations - Lightning arrester.

UNIT III **9 Hours**

PRINCIPLES OF ILLUMINATION

Visual tasks - Factors affecting visual tasks - Modern theory of light and colour - Synthesis of light - Additive and subtractive synthesis of colour - Laws of illumination - Classification of lighting - Artificial light sources - Spectral energy distribution - LED lightings - Daylight factor - Design of modern lighting - Lighting for stores, offices, schools, hospitals and house lighting - Special features required for physically handicapped and elderly in building types - Specifications of National Building Code of India.

UNIT IV **9 Hours**

REFRIGERATION PRINCIPLES

Thermodynamics - Refrigerants - Vapour compression cycle - Compressors - Evaporators - Refrigerant Control devices - Cooling towers - Starters - Air handling units - Water piping - Vapour Absorption Machine(VAM) - Window type and packaged air conditioners - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C. systems.

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Fire resistant construction materials - Safety regulations as per NBC - Planning considerations in buildings - Fire escapes systems - Heat and smoke detectors - Automatic sprinklers - Fire Fighting pump and water storage - Fire hydrants - Dry and wet risers.

Total: 45 Hours

Reference(s)

1. Roger Greeno and Fred Hall, Building Services Handbook (8th edition), Routledge Publishers, 2015.
2. G. Steffy, Architectural Lighting Design, John Wiley and Sons, 2008.
3. J. Killinger and L. Killinger, Heating and Cooling Essentials, Goodheart-Wilcox Publishers, 2003.
4. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1988.
5. R. Udhayakumar , A text book of Building services, Eswar Press, 2007.
6. SP 7 (2005) : National Building Code of India 2005.

22CE014 CONCEPTUAL PLANNING AND BYE LAWS 3 0 0 3

Course Objectives

- To provide a broad exposure to the students about the concepts of Planning necessary in Civil Engineering practice
- To make the students familiar with National Building Code of India and other relevant codes forthe functional design of residential and industrial buildings
- To provide a broad exposure to the students about the city planning and tender process

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations. PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the requirement of geometrical design as per NBC and learning the importance of projects
2. To provide the basic knowledge on planning approval procedures and their limitations
3. Recall the general guidelines for various buildings as per NBC
4. To impart the knowledge on Master planning of a city and their elements
5. To make the students understand the Tender process, working and procedure in India

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1		1								1	
2	1	2	3		1									2
3	1	2	3		1								1	
4	1	2	1		1									
5	1	2	1		3								1	2

UNIT I **9 Hours**

CIVIL ENGINEERING PROJECTS

Introduction- Consideration for a good project -Project Personnel - Contacts- Geometrical design of buildings-National Building Code (NBC) Specifications for various buildings.

UNIT II **9 Hours**

GOVERNMENT APPROVAL PROCEDURES

Requirements for site approval - Application for planning - Permission and building permit - Boundaries setbacks for domestic and high rised buildings -Provision for differently abled, elderly and children - Requirements of a plan - Inspection procedures- Plan sanction - Limitations - Cancellation of permit - Demolition of buildings - Renewal of permit

UNIT III **9 Hours**

FUNCTIONAL DESIGN OF BUILDINGS

Introduction -Functional design of Residential, Commercial and Industrial buildings - Rules and regulations as per National Building Code of India (NBC 2016) - Fire safety of high rise and commercial buildings (NBC 2016) - Evaluation

UNIT IV **9 Hours**

CITY PLANNING

Urban development - Zoning - Regulations - Requirements for City planning - Spaces excluded from FSI andcoverage computation - Special character areas - Planning for apartments industrial and institutional sectors - Delegation of powers

UNIT V **9 Hours**

TENDER PROCESS IN INDIA

Bids Tenders and proposals - Government Tender process - Contracts - Types of Tenders - E - Tendering - System of working - Guidelines and procedures - Government and private sectors - Preparation of tender documents - Big Civil Engineering Construction Companies in India

Total: 45 Hours

Reference(s)

1. B S Ramaswamy, Contracts and Their Management, LexisNexis; 4th edition (2013)
2. Anurag.K. Agarwal, Contracts and Arbitration for Managers, Sage Publications Pvt. Ltd; 1 edition(26 January 2016)
3. Rangwala, Town planning, Charotar Publishing House Pvt. Limited, 2009
4. National Building code of India (NBC) 2016
5. National2.http://www.tn.gov.in/tcp/building_plan.html Building Code of India ,SP 7 : 2016
6. Ernst Neufert, Peter Neufert,Architects Data, Wiley Publisher; 4th edition (2 March 2012)

22CE015 COST EFFECTIVE CONSTRUCTION AND GREEN BUILDING

3 0 0 3

Course Objectives

- To impart knowledge on different concepts of sustainable design and cost effective methods to best fitfor a specific construction project.
- To expose the concept of green building techniques for the construction project.
- To impart knowledge on green practices and rating systems

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reachingsubstantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the suitable cost effective construction materials.
2. Select the different types of cost effective systems.
3. Summarize the contribution of buildings in global warming and issues in society and environment.
4. Understand the principle of sustainable development in green building design.
5. Apply the process of green energy in buildings and know the rating systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2					3					2	1	2
2	1	3					2					2	2	1
3	2	1					3					3	1	2
4	1	3					2					1	2	1
5	3	2					1					2	1	2

UNIT I **9 Hours**

INTRODUCTION TO COST EFFECTIVE CONSTRUCTION MATERIALS

Cost effective construction materials - Stone and Laterite blocks - Burned Bricks -Fly ash blocks - Concreteblocks - Geopolymer concrete - Stabilized mud blocks - Lime - Pozzolana cement - Gypsum board - Bamboo - Lightweight construction materials - Natural and synthetic fibres - Recycling of building materials.

UNIT II **9 Hours**

COST EFFECTIVE METHODS

Cost effective building technologies - Wall construction - Rat trap bond - Cavity wall - Ferro cement and Ferroconcrete constructions - Alternative beams, columns and roofing Systems - Door and window frames - Filler slab - Composite beam and panel Roof - Pre-engineered building elements.

UNIT III **9 Hours**

GREEN BUILDING DESIGN

Contribution of buildings towards global warming - Environmental benefit - Health and social benefits - Major energy efficient areas for buildings - Embodied energy in materials - Green materials and design - Comparison of initial cost of green building V/s conventional building - Life cycle cost of buildings.

UNIT IV **9 Hours**

GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

Solar energy - Wind energy - Design for sustainability - Sustainable structure and Green Building - Principles of sustainable development in building design - Characteristics of sustainable buildings- Sustainably managed materials - Integrated lifecycle design of materials and structures.

UNIT V **9 Hours**

GREEN PRACTICES AND RATING SYSTEMS

Renewable energy Controlling the water cycle Impact of materials on the environment Optimizing Construction Site Management Environmental management of buildings - Green Building Evaluation SystemsLEED Certification and GRIHA Green Globe Certification Case studies.

Total: 45 Hours

Reference(s)

1. Kibert, C. Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, 2005.
2. Edward G Pita, An Energy Approach- Air-conditioning Principles and Systems, Pearson Education,2003.
3. K S Jagadeesh, B V Venkatta Rama Reddy & K S Nanjunda Rao, Alternative Building Materials and Technologies, New Age International Publishers.
4. Asko Sarja, Integrated Life Cycle Design of Structures, SPON Press 3.
5. D S Chauhan and S K Sreevasthava, Non conventional Energy Resources, New Age International Publishers.
6. Daniel Vallero and Chris Brasier; Sustainable Design- The science of sustainability and Green Engineering; Wiley; 2008.

22CE016 PREFABRICATED STRUCTURES AND PRE-ENGINEERED BUILDING

3 0 0 3

Course Objectives

- To impart knowledge on prefabricated elements and the technologies used for fabrication and erection
- To impart knowledge on the applications of prefabricated elements in construction
- To make students to get exposure on design principles and erection technologies

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations. PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Understand the general principles of fabrication.
2. Illustrate the prefabricated components and its connections.
3. Demonstrate the suitable techniques for the Production and erection of different types of members.
4. Analysis and design of precast industrial structures.
5. Compare the design principles of conventional steel building and Pre Engineered Buildings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	1	-	2	3								1	2
2	2	3	1	3									2	1
3	-	1	-	2	3								1	2
4	-	3		2	1								1	2
5	2	2	1	3									1	2

UNIT I **9 Hours**

INTRODUCTION

Need for prefabrication - Principles - Materials - Types of Prefabrication - Prefabrication systems and Structural schemes - Modular co-ordination - Prefabrication of load-carrying members - Disuniting of structures

UNIT II **9 Hours**

PREFABRICATED COMPONENTS

Behaviour and types of structural components - Large panel systems - Roof and floor panels -Ribbed floor panels - Wall panels - Footings - Beams and Columns - Shear walls - Joints for different structural connections - Effective sealing of joints for waterproofing - Provisions for non-structural fastenings.

UNIT III **9 Hours**

PRODUCTION AND HOISTING TECHNOLOGY

Production - Planning of production setup - Manufacturing methods - Stationary and mobile production - Organizing of production - Shuttering and mould design - Storage of precast elements - Dimensional tolerances. Equipment for hoisting and erection - Transportation and Erection - Erection of R.C.Structures - Beams, Slabs, Wall panels and Columns.

UNIT IV **9 Hours**

DESIGN PRINCIPLES

Designing and detailing of precast unit for factory structures - Purlins, Principal rafters, roof trusses, lattice girders, gable frames - Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc - Importance of avoidance of progressive collapse.

UNIT V **9 Hours**

PRE - ENGINEERED BUILDINGS

Pre- Engineered Buildings Vs Conventional Steel Buildings - Design procedure of Pre- Engineered Buildings -Applications.

Total: 45 Hours

Reference(s)

1. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use ofPrecast Concrete, Netherland Betor Verlag, 2009
2. L. Mokk, Prefabricated Concrete for Industrial and Public Structures, Publishing House of theHungarian Academy of Sciences, Budapest, 2007.
3. T. Koncz, Manual of Precast Concrete Construction, Vol. I, II, III & IV, Berlin, 1988.
4. B. Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam, London,New York, 1998.
5. Prefabricated Systems: Principles of Construction, Sharon Chung-Klatte, Ulrich Knaack, Reinhard Hasselbach, Birkhauser, 2013.

22CE017 ENERGY EFFICIENT BUILDINGS 3 0 0 3

Course Objectives

- To learn the green buildings concepts applicable to alternate design and to incorporate renewableenergy systems in buildings
- To acquire knowledge on landscape and Heating, Ventilation and Air conditioning in Buildings
- To impart knowledge on Eco friendly building concepts

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations. PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Illustrate the design aspects of energy efficient buildings
2. Gain knowledge on the role and importance of landscape
3. Design HVAC components in buildings
4. Acquire knowledge on the process of heat transmission in buildings
5. Outline the renewable energy systems in buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	1		1								1	2
2	1	3	2		2								1	2
3	-	-	1		1								1	2
4	1	-	1		1								2	1
5	-	3	1		1								1	2

UNIT I **9 Hours**

INTRODUCTION

Conventional versus Energy Efficient Buildings Historical Perspective Water Energy IAQ requirement analysis Future building design aspects Criticality of resources and needs of modern living Codal Provisions.

UNIT II **9 Hours**

LANDSCAPE AND BUILDING ENVELOPES

Energy efficient Landscape design Micro climates various methods Shading Water bodies Building envelope Building materials Envelope heat loss and heat gain its evaluation Paints Insulation Design methods and tools

UNIT III **9 Hours**

HEATING, VENTILATION AND AIRCONDITIONING IN BUILDINGS

Natural Ventilation Passive cooling and heating Application of wind, water and earth for cooling evaporative cooling radiant cooling Hybrid Methods Energy Conservation Measures Thermal Storage integration in buildings

UNIT IV **9 Hours**

HEAT TRANSMISSION IN BUILDINGS

Surface co-efficient air cavity internal and external surfaces Overall thermal transmittance Wall and windows Heat transfer due to ventilation infiltration Internal heat transfer Solar temperature Decrement factor Phase lag Design of day lighting Computer packages for carrying out thermal design of buildings and predicting performance

UNIT V **9 Hours**

PASSIVE COOLING

Passive cooling concepts Evaporative cooling Radioactive cooling Application of wind Water and earth for cooling Shading paints and cavity walls for cooling Roof radiation traps Earth air-tunnel Introduction of renewable sources in buildings Solar water heating Small wind turbines Stand alone PV systems Hybrid system Economics

Total: 45 Hours

Reference(s)

1. Clarke, Joseph. Energy simulation in building 2nd Edition, Routledge,2007.
2. Krishan, Arvind, Climate responsive architecture a design handbook for energy efficient buildings,Tata McGraw-Hill Education, 2001.
3. Krieder, J and Rabi A Heating and Cooling of buildings: Design for Efficiency, McGraw Hill, 1994.
4. 4. Paul tymkow, Savvas tassov, Maria kolokotrani and Hussam jouhara, Building Services and Designfor Energy efficient building 2nd Edition, Taylor and Francis, Routledge.
5. Yap Eh Energy Efficient Buildings, Intech publications, 2018.

22CE018 CONSTRUCTION MANAGEMENT AND SAFETY

3 0 0 3

Course Objectives

- To study and understand the concept of planning and scheduling process of construction practices
- To make students to understand the concept of planning and cost control monitoring and accounting
- To impart knowledge on construction safety and safety in handling the equipment's for construction.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Explain the stages involved in a project and analyze the obligatory services to betaken up whileperforming a construction activity.
2. Apply the scheduling techniques for planning construction projects.
3. Analyze the cost control, monitoring methods and quality control.
4. Identify hazards and its remedial measures in the construction industry
5. Identify the safety measures in handling construction equipment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	1								2	1
2	3	3	1	1	1								2	1
3	3	3	1	1	1								2	1
4	3	3	1	1	1								2	1
5	3	2	1	2	1								2	1

UNIT I **9 Hours**

FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT

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 **9 Hours**

PLANNING AND ORGANIZING CONSTRUCTION PROJECT

Construction Project organization Planning Project work Scope and integration Processes Defining Project Activities Scheduling Project CPM PERT Precedence Network Analysis Planning and organizing project resources such as manpower material equipment Time and cost for construction site.

UNIT III **9 Hours**

COST CONTROL MONITORING AND ACCOUNTING

The Cost Control Problem the Project Budget Forecasting for Activity Cost Control Financial Accounting Systems and Cost Accounts Control of Project Cash Flows Schedule Control Schedule and Budget Updates Relating Cost and Schedule Information Total Quality Control.

UNIT IV **9 Hours**

CONSTRUCTION SAFETY

Quality and Safety Concerns in Construction Organizing for Quality and Safety Work and Material Specifications Importance of Safety during project construction Accidents and their Causes General precaution to hazardous atmosphere and materials Safety facilities at construction sites Training to project staff and operation staff Emergency rescue equipment Costs of Construction Injuries Legal Implications.

UNIT V **9 Hours**

SAFETY MEASURES IN HANDLING CONSTRUCTION EQUIPMENTS

General requirements of safety in concrete construction Handling of Concrete forms and shoring Safety measures for hoisting and erection of prefabricated elements OSHA Occupational Safety and Healthy Administration for Prestressing Operations Risk Assessment for erecting RC & Steel members Electrical safety in construction site.

Total: 45 Hours

Reference(s)

1. Construction Engineering & Management by Dr. S. Seetharaman - Umesh Publications, Delhi.
2. P. S. Gahlot , B. M. Dhir, Engineering Construction Planning AndManagement, New AgeInternational, New Delhi (2018)
3. Dr.Mahesh Varma, "Construction Equipment and its planning and Application",Metropolitan BookCompany, New Delhi. 1983.
4. Sharma S.C. Construction Equipment and Management Khanna Publishers, New Delhi, 2019.
5. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control,Tata McGraw-Hill Publishing Company, New Delhi, 2014

22CE019 GROUND IMPROVEMENT TECHNIQUES 3 0 0 3

Course Objectives

- To understand the principles, applications, and design procedures for various ground improvement techniques.
- Gain competence in properly evaluating alternative solutions, and the effectiveness before, during andafter using ground improvement.
- To understand the stabilization process using admixtures and grouting

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the various ground improvement techniques.
2. Infer the design methods of dewatering systems.
3. Identify the suitable chemical admixture for stabilization.
4. Select the suitable types of grout and injection method for ground improvement.
5. Assess the effectiveness of a ground improvement technique by geo synthetics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2	1								1	2
2	1	2	2	1	2								2	1
3	1	3	3	1	1								1	2
4	1	3	2	2	2								2	1
5	1	2	3	1	1								1	2

UNIT I **9 Hours**

NECESSITY OF GROUND IMPROVEMENT AND MECHANICAL STABILIZATION

Different types of problematic soils - Need for Ground Improvement - Emerging trends in ground Improvement - Mechanical stabilization - Principles and methods of shallow and deep soil compaction - Vibro replacement and Vibro compaction - Dynamic compaction - Properties of compacted soil and compaction control.

UNIT II **9 Hours**

DEWATERING TECHNIQUES

Hydraulic modification - Drainage techniques - Well points - Deep well, preloading, vertical drains, vacuum consolidation, Electro kinematic dewatering - Design of dewatering systems.

UNIT III **9 Hours**

STABILIZATION BY ADMIXTURES

Chemical modification - Cement stabilization and cement columns, Lime stabilization and lime columns - Stabilization using industrial wastes - Methods of applications in the field - Stabilization of expansive clays.

UNIT IV **9 Hours**

STABILIZATION BY GROUTING

Types of grouts and grouting techniques - Grouting equipment and machinery - Injection methods - Grout monitoring - Selection of grout - Design aspects.

UNIT V **9 Hours**

GEOSYNTHETICS IN GROUND IMPROVEMENT

Concept of reinforcement - Geo synthetics - Types, functions and applications - Stability analysis of geo grid reinforced earth retaining wall - Internal and External - Application of Geotextiles as filtration, drainage and separation in the pavement works - Soil nailing.

Total: 45 Hours

Reference(s)

1. Van Impe W.E., Text Book on Soil Improvement Technique and their Evolution, Balkema Publishers, Netherlands, 1994.
2. M. R. Hausman, Engineering Principles of Ground Modification, McGraw Hill Book Co., Singapore,1990.
3. Purushothama Raj, P. Ground Improvement Techniques, Laxmi Publications, New Delhi, 2005.
4. Peter G. Nicholson, Soil Improvement and Ground Modification Methods, Butterworth-Heinemann publications, Elsevier, 2015.
5. Moseley M.P. and Kirsch K., Ground Improvement, 2nd Edition, Spon Press, Tailor & Francis Group,London, 2004.
6. Koerner, R.M., Design with Geosynthetics, 6th Edition, Prentice Hall, New Jersey, 2002.

22CE020 GEOENVIRONMENTAL ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on the Geotechnical engineering problems associated with soil contamination,
- To understand the measures on safe disposal of waste
- To make students aware about remediate the contaminated soils by different techniques thereby protecting environment

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the soil-pollutant interaction and assess the modification of soil properties
2. Categorize the process of contaminant transport and characterize the contaminated sites
3. Classify different techniques for the remediation of contaminated Sites
4. Design the cover system by identifying the suitable components of landfill
5. Analyze the possible utilization of waste based on their characteristics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-										2	1
2	3	-	-	1									2	1
3		2	-										2	1
4	1	-	2										1	2
5	1	2	-	2									2	1

UNIT I **9 Hours**

SOIL POLLUTANT INTERACTION

Role of Geo-Environmental Engineering - sources, generation and classification of wastes- causes and consequences of soil pollution -factors influencing soil-pollutant interaction-modification of index- physical, chemical and engineering properties

UNIT II **9 Hours**

CONTAMINANT TRANSPORT AND SITE CHARACTERISATION

Transport of contaminant in subsurface - advection, diffusion, dispersion - chemical process in subsurface - sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization - biological process in subsurface - characterization of contaminated sites

UNIT III **9 Hours**

WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES

In situ containment - vertical and horizontal barrier - soil remediation - soil vapour extraction, electro kinetic remediation, soil heating, vitrification, bioremediation, phyto remediation - ground water remediation -pump and treat, In situ flushing, permeable reacting barrier

UNIT IV **9 Hours**

LAND FILLS AND SURFACE IMPOUNDMENTS

Site selection for landfills - Components of landfills - liner system - soil, geomembrane, geosynthetic clay, geocomposite liner system - leachate collection-construction and operation of landfill-landfill cover -disposal of slurry waste in ponds and impoundments

UNIT V **9 Hours**

UTILIZATION OF WASTE

Evaluation of waste materials- flyash, municipal sludge, plastics, scrap tire, blast furnace slag - physical, chemical and biological characteristics-geotechnical reuse of waste materials

Total: 45 Hours

Reference(s)

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering - John Wiley and Sons, INC, USA, 2004.
2. Sharma H D and Reddy K R, Geoenvironmental Engineering: Site remediation, Waste containment and Emerging Waste Management Technologies, John Wiley & Sons, Inc. Hoboken, New Jersey, 2004.
3. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1995.
4. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 2014.
5. Bagchi A, Design of landfills and integrated solid waste management, John Wiley & Sons, Inc., USA2004

22CE021 INTRODUCTION TO GEOTECHNICAL EARTHQUAKE ENGINEERING

3 0 0 3

Course Objectives

- To impart knowledge on dynamic properties of the soil.
- To make better understanding about seismic hazard analysis.
- To make students aware about evaluation of liquefaction potential of the soil.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reachingsubstantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.

PO4 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO5 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and culturalissues and the consequent responsibilities relevant to the professional engineering practice.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the source and magnitude of earthquake
2. Illustrate the dynamic behaviour of soil
3. Evaluate the seismic hazard by deterministic approach
4. Compare the types of liquefaction and evaluate its hazards
5. Evaluate the liquefaction potential by different methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1		-										1
2	-	1		2									2	1
3	-	1	2	2										1
4	1				2								2	
5		1	2											2

UNIT I **9 Hours**

SEISMOLOGY

Internal Structure of the Earth - Continental Drift and Plate Tectonics - Faults - Elastic rebound theory - Different sources of Seismic Activity - Geometric Notation - Location of Earthquakes - Size of Earthquakes

UNIT II **9 Hours**

DYNAMIC PROPERTIES OF SOILS

Measurement of Dynamic Properties of soils - Field Tests - Low strain - Seismic Reflection - Seismic Refraction - Horizontal layering - Steady-State Vibration - Spectral analysis of surface wave - Seismic cross hole - Down Hole - Uphole tests - Laboratory tests - Resonance Column Test - Bender Element.

UNIT III **9 Hours**

SEISMIC HAZARD ANALYSIS

Identification and Evaluation of Earthquake Sources - Geologic Evidence - Tectonic Evidence - HistoricalSeismicity - Instrumental Seismicity - Deterministic Seismic Hazard Analysis

UNIT IV **9 Hours**

LIQUEFACTION

Liquefaction - Flow liquefaction - Cyclic Mobility - Evaluation of liquefaction Hazards - LiquefactionSusceptibility Criteria - Historical, Geological and Compositional State.

UNIT V **9 Hours**

EVALUATION OF LIQUEFACTION POTENTIALMENT

Evaluation of Initiation of Liquefaction - Cyclic stress approach - Characterization of Liquefaction Resistance - SPT Test - Various correction factor - Factor of Safety.

Total: 45 Hours

Reference(s)

1. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, PearsonEducation Inc and Donling Kindersley Publishing Inc. 2013
2. Roberto Villaverde, Fundamental Concepts of Earthquake Engineering, CRC Press Taylor & FrancisGroup, 2009.
3. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing New Delhi, 2000.
4. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi,1998.
5. McGuire, R.K. Seismic Hazard and Risk Analysis Earthquake Engineering Research Institute, 2004.
6. Mahanti, N.C. Samal, S.K. Datta, P. Nag.N.K., Diaster Management, Narosa Publishing House, NewDelhi, India, 2006.

22CE022 REINFORCED SOIL STRUCTURES 3 0 0 3

Course Objectives

- To make the students gain adequate knowledge on reinforced soil structures.
- To impart knowledge on principles and design of reinforced soil structures
- To make students aware about geosynthetics in environmental geotechnics and guidelines

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. To develop knowledge about the concept of Reinforced Earth, materials and testing.
2. Design the geotextiles, geogrids, geonets, geomembranes used reinforced earth.
3. Design the soil nailing and geocomposite used reinforced earth.
4. Apply the Reinforced earth technique in civil engineering
5. Apply the Geosynthetics in Environmental Geotechnics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	1								2	1
2	3	3	3	1	1								2	1
3	3	3	3	1	1								2	1
4				1	1								2	1
5			2	1	1								2	1

UNIT I **9 Hours**

REINFORCED EARTH

Introduction; Types and functions; Materials and manufacturing processes; Properties and test methods, Standards and Codes of Practice; Soil-geosynthetic interaction

UNIT II **9 Hours**

PRINCIPLES AND DESIGN

Principles of soil reinforcement; Design of Earth Reinforced Structures with the specifications of itsproperties: geotextiles, geogrids, geonets, geomembranes-Analysis of failure and factor of safety.

UNIT III **9 Hours**

MODERN TRENDS IN REINFORCED EARTH

Soil Nailing Introduction and feasibility Criteria Types Driven and Grouted nails Principles of Design and Construction Methodology Designing with geocomposites Geocomposites in seperation reinforcement reinforced geotextile composites reinforced geomembrane composites reinforced soil composites using discontinuous fibres and meshes continuous fibres and three dimensional cells geocomposites in drainage andfiltration

UNIT IV **9 Hours**

APPLICATION

Construction of geosynthetic reinforced soil retaining structures walls and slopes, Codal provisions. Bearing capacity improvement, embankments on soft soils, Geosynthetics in Pavements, Geosynthetics in roads, airports and railways, separations, drainage and filtering in road pavements and railway tracks, overlay design and construction. Seismic aspects of geosynthetic applications Quality control and in-situ monitoring; Cost analysis Case Histories.

UNIT V **9 Hours**

GEOSYHTETICS IN ENVIRONMENTAL GEOTECHNICS AND GUIDELINES

AASHTO and other relevant guidelines, Pipeline and drainage systems, Geosynthetics in Environmental Control, Liners for ponds and canals, covers and liners for landfills material aspects and stability considerations, Landslides occurrences and methods of mitigation Erosion causes and techniques for control Applications in Tunnels Case Histories.

Total: 45 Hours

Reference(s)

1. G. L. Sivakumar Babu, An Introduction to Soil Reinforcement and Geosynthetics, University Press,2005.
2. R. M. Koerner, Designing with geosynthetics, Pearson Education Inc., 2005.
3. G. V. Rao, Geosynthetics an Introduction, Sai Master Geoenvironmental Services Pvt. Ltd.Hyderabad, 2011.
4. Shukla, Fundamentals of Geosynthetic Engg. Imperial College Press, London, 2006
5. Clayton, C. R. I., Milititsky, J. and Woods, R. I., Earth Pressure and Earth Retaining Structures,Blackie Academic & Professional, 1993.
6. Ingold, T, Reinforced Earth, Thomas Telford Ltd., 1982.

22CE023 ROCK MECHANICS AND APPLICATIONS 3 0 0 3

Course Objectives

- To impart knowledge on fundamentals of rock mechanics
- To make students aware about application in solving simple problems associated with rock slopesand underground openings.
- To impart knowledge on the mechanics of rock and its applications in underground structuresand rock slope stability analysis.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reachingsubstantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Classify the rocks based on their index properties
2. Evaluate the behaviour of rock under different loading condition
3. Suggest various techniques to improve the in-situ strength of rocks
4. Evaluate the bearing Capacity of foundations on rocks
5. Recall installation methods for rock reinforcement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1									1	2
2	3	1		2										1
3	1	3		1									1	2
4	3	1		2										1
5	1	3	1	-									1	2

UNIT I **9 Hours**

CLASSIFICATION OF ROCKS

Types of Rocks – Physico mechanical properties of rocks - Field and Laboratory tests for physical and mechanical properties- Classification of rock masses - the value of RMR and ratings - Field estimations - NewAustralian Method

UNIT II **9 Hours**

STRENGTH CRITERIA OF ROCKS

Joint characteristics - Planes of weakness - Stress-strain behavior of intact rock and rock mass under hydrostatic compression and deviatoric loading - Modes of rock failure - Mohr-Coulomb failure criterion andtension cut-off - Hoek Brown failure criterion.

9 Hours

UNIT III

INSITU STRESSES IN ROCKS

In-situ stresses - Strain gauge Rosette and stress measurement techniques - Methods - Hydraulic fracturing, flatjack, over coring and under coring methods - Stress around the underground excavation - Zone of influence

UNIT IV **9 Hours**

SLOPE STABILITY AND BEARING CAPACITY OF ROCKS

Rock slopes and slope failures - Types and role of discontinuities - Slope analysis and factor of safety -remedial measures for critical slopes - Bearing Capacity of foundations on rocks

UNIT V **9 Hours**

ROCK REINFORCEMENT

Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, grouting - stress transfermechanism, types and installation methods.

Total: 45 Hours

Reference(s)

1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1999.
2. Hudson, A. and Harrison, P., Engineering Rock mechanics - An introduction to the principles, Pergamon publications, 1997.
3. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
4. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & FrancisGroup, London and New York, 2002.
5. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt.Ltd., 2014
6. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer verlag, Berlin,1990.

22CE024 EARTH RETAINING STRUCTURES 3 0 0 3

Course Objectives

- To understand lateral earth pressure theories and pressure theories and design of retaining walls.
- To design anchored bulkheads by different methods.
- To understand pressure envelops and design of various components in braced cuts and cofferdams.
- To understand stability of earth dams and its protection and construction.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Students will be able to understand the basics of earth dams with their components and the calculation of seepage
2. Students will be able to analyze the basics of lateral earth pressure with retaining wall types.
3. Students will be able to analyze the anchored bulk heads, retaining structures, slopes, and cuts.
4. Students will be able to analyze the stability analysis and seepage control measures.
5. Students will be able to analyze protection of earth dams with its performance observations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											1	1
2	2	1											1	2
3	2	1											1	2
4	1	2											2	1
5	2	1											1	2

UNIT I **9 Hours**

INTRODUCTION

Earth dams types of dams Design details upstream and downstream slope protection central and inclined cores types and design of filters. Seepage analysis and control seepage through dam and foundations control of seepage in earth dam and foundation.

UNIT II **9 Hours**

LATERAL PRESSURE

Basic concepts Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures Culmanns, Rebhans, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quake, wave effect, stratification, type of backfill, wall friction and adhesion. Retaining walls: Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting.

UNIT III **9 Hours**

ANCHORED BULKHEADS

Classification of anchored bulkheads, free and fixed earth support methods. Rowes theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods and dead man Bracedcuts and Cofferdams: Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils.

UNIT IV **9 Hours**

EARTH DAMS- STABILITY ANALYSIS

Classification, seepage control in embankments and foundations, seepage analysis, stability analysis upstreamand downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishops method.

UNIT V **9 Hours**

EARTH DAMS -PROTECTION

Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.

Total: 45 Hours

Reference(s)

1. Foundation design by W. C. Teng, Prentice Hall,1962
2. Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.
3. Earth and Rock-Fill Dams: General Design and Construction Considerations by UnitedStates ArmyCorps of Engineers, University Press of the Pacific,2004
4. Soil mechanics in engineering and practice by Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri,3rdEdition. Wiley India Pvt Ltd,2010.

22CE025 URBAN TRANSPORTATION PLANNING AND SYSTEMS

3 0 0 3

Course Objectives

- To enhance the knowledge of students on urban transportation planning techniques
- To distinguish the successful features of innovative transportation planning schemes
- To impart knowledge on transportation economics

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify and analyze the present trip pattern of transportation.
2. Interpret the future trips and assign the trips using trip assignment.
3. Design a transportation network with different models.
4. Identify the acquisition of skills on mass transportation systems.
5. Infer the awareness on the transportation economics based on demands.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2										2		
2	2	1	3										1	1
3	1		3	2								2		1
4	1		2	3									1	2
5	2	1	3											

UNIT I **9 Hours**

INTRODUCTION TO PLANNING PROCESS

Role of Transportation and Changing Concerns of Society in Transportation Planning TransportationProblems and Problem Domain; Objectives and Constraints; Flow Chart for Transportation Planning Process
- Concept of Travel Demand - Survey on Data collection - Urban travel characteristics - Land use transport interaction.

UNIT II **9 Hours**

METHODS OF TRAVEL DEMAND ESTIMATION

Assumptions in Demand Estimation - Introduction to Transportation Planning Practices; Four Stages of Planning -Trip generation analysis - Zoning - Trip generation models - Zonal models - Household models - Category analysis - Trip attractions of work centers - Trip distribution analysis - Trip distribution models- Problems in distribution models.

UNIT III **9 Hours**

MODE CHOICE AND ROUTE SPLIT ANALYSIS

Mode Choice - Mode split analysis - Mode split Models - Mode choice behavior, competing modes, mode split curves, probabilistic models - Traffic assignment - Route split analysis: Elements of transportation networks, nodes and links - Minimum path trees.

UNIT IV **9 Hours**

MASS TRANSPORTATION SYSTEM

History and role of Transit - Recent Trends Mass Transportation Characteristics - Mass rapid transit system -Light rail transit - Personal rapid transit, guided way systems, cabin taxi and dual mode bus - Paratransit systems - Demand responsive system - Intermediate public transport.

UNIT V **9 Hours**

TRANSPORT ECONOMICS

Basic principles of economic evaluation - Method of economic evaluation - Transportation costs - Vehicle operating costs - Financing of road projects - Methods - Private Public Partnership - Toll collection - Build- Operate-Transfer (BOT, BOLT) Schemes - Risk Analysis - Value for Money analysis - Case Studies.

Total: 45 Hours

Reference(s)

1. C. Jotin Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 3rdedition, 2013, ISBN-13: 978-0130335609.
2. L. R. Kadiyali, Traffic and Transportation Planning, Khanna Publishers Ltd., New Delhi, 2017, ISBNNo. 978-81-7409-220-X.
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. C. S. Papacostas and Prevedouros, Transportation Engineering and Planning, Prentice Hall of India,New Delhi, 2013, ISBN-13: 978-0130814197
5. B. G. Hutchinson, Principles of Urban Transportation System Planning, Tata McGraw Hill, 2007
6. Meyer, Michael D, ITE Transportation Planning Handbook, John Wiley & Sons 2016

22CE026 MASS TRANSPORTATION SYSTEMS 3 0 0 3

Course Objectives

- To enhance the knowledge on function of public transit and the role of government units
- To impart knowledge on mass transportation system
- To enable the students to get popular in conducting various traffic surveys and interpretationresults.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Analyze the four various modes of mass transportation
2. Understand the Acquisition of skills on mass transportation systems
3. Identify the cost benefit ratios of transport systems by different methods.
4. Better knowledge on planning of transit systems.
5. Knowledge on developments in public transportation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3										1	
2	3	2	1											1
3	1	3	2									2	1	1
4	2	1	3									2	1	2
5	2	1	2											2

UNIT I **9 Hours**

INTRODUCTION

Urban transportation systems - Mass rapid transit system - Light rail transit - Personal rapid transit, guided way systems, cabin taxi, dual mode bus - Para transit systems - Demand responsive system - Intermediate public transport.

UNIT II **9 Hours**

MASS TRANSPORTATION SYSTEM

History and role of Transit - Recent Trends Mass Transportation Characteristics - Demand Characteristics - Spatial - Temporal and Behavioral - Characteristics of Transportation Demand. - Urban Mass Transportation

Planning - Demand Surveys - Transit oriented land use development.

9 Hours

UNIT III

DESIGN AND EVALUATION OF MASS TRANSPORT

Four Stages of Planning - Performance Evaluation of Mass Transport System - Structure of Decision Ma king, - Evaluation and Selection Methods - Selection Procedures - Economic Evaluation Methods. Terminalsand their functions - Design, Typical Characteristics. - Scheduling, Service Analysis, Vehicle Dispatch Policy, Vehicle Requirements, Spacing of Bus Tropos, - Route Spacing and Performance - Operational and Management Issues - Reserved Bus Lanes - Signal Preemption, - Dial- a-Bus

UNIT IV **9 Hours**

TRANSIT PLANNING

Introduction - Definition - Shuttle systems - Corridors - Two dimensional system - Realistic cases only - Flexible transit - Individual public transportation system -Collective transportation

UNIT V **9 Hours**

PUBLIC TRANSIT

Introduction to public transit - History - Personal public transit experiences -Public transportation system characteristics - Mass transit definitions and classifications - Route development - stop location and stopping policy - Schedule development.

Total: 45 Hours

Reference(s)

1. C. Jotin Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 2003
2. Hutchinson, B.G., Principles of Urban Transport Systems Planning Mc Graw Hill,New York, 1974
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. Vuchic V.R., Urban Public Transportation System and Technology, Prentice Hall, Inc. EnglewoodCliffs, New Jersey, 1981.
5. Agarwal M.K., Urban Transportation in India, INAE, Allied Publishers Ltd., 1996,Grey G.E. & Hoel,LA, Public Transportation? Prentice Hall, Englewood

22CE027 TRAFFIC ENGINEERING AND MANAGEMENT

3 0 0 3

Course Objectives

- To Provide an insight in traffic and its components, factors affecting road traffic and the design of intersection
- To enable the students to get familiarize in conducting various traffic surveys, interpretation andanalysis.
- To enhance an insight on different traffic regulations methods and management methods.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learningin the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Acquire and apply knowledge of traffic, its components, and factors affecting road traffic in intersection design
2. Identify the sampling data in conducting various surveys and analysis
3. Capable of understanding traffic movements and designing islands, intersections and road lighting.
4. Capable of designing signals, redesigning the existing signals.
5. Able to remember traffic regulations, impact of noise pollution, air pollution and the method of controlling them.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	-										
2	2	1	-	-									1	2
3	2	-	1	3								2		1
4	1	-	2	3								3	1	
5	2	1	3	-										2

9 Hours

UNIT I

INTRODUCTION

Introduction -Characteristics of Vehicles and Road Users - Skid Resistance and Braking Efficiency, Components of Traffic Engineering- Road, Traffic and Land Use Characteristics - Traffic problems in India -Integrated development of cities and towns.

9 Hours

UNIT II

TRAFFIC SURVEYS AND ANALYSIS

Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Basics of Traffic flow theory.

UNIT III **9 Hours**

GEOMETRIC DESIGN OF INTERSECTIONS

Conflicts at Intersections - Classification of At-Grade Intersections, - Channelized Intersections - Principles of Intersection Design, Elements of Intersection Design, Rotary design, Grade - Separation and interchanges.

UNIT IV **9 Hours**

TRAFFIC CONTROL

Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design.

UNIT V **9 Hours**

TRAFFIC MANAGEMENT

Traffic Management- Transportation System Management (TSM) - Travel Demand Management (TDM), IRCguidelines - Traffic Forecasting techniques, Restrictions on turning movements, One- way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes, Introduction to Intelligent Transportation System (ITS).

Total: 45 Hours

Reference(s)

1. L. R. Kadiyali, Traffic and TransportationPlanningg, Khanna Publishers Ltd., New Delhi, 2017, ISBNNo. 978-81-7409-220-X
2. Drew, D.R. `Traffic Flow Theory and Control", McGraw Hill Book Co. ISBN-13: 978- 0070178311.
3. Institute of Transportation Engineers, `Manual of Transportation Engineering Studies", Prentice Hall,1992, ISBN No. 9780139267918
4. S. K. Khanna ,C. E. G. Justo, A.Veeraraghavan, Highway Engineering, Nem Chand and Bros.,Roorkee, 2015 (tenth edition) ISBN 978-81-85240-80-0
5. Papacostas, C.A., Fundamentals of Transportation Engineering", Prentice-Hall of India PrivateLimited, New Delhi.2000. ISBN-10: 0133448703.
6. Roger P. Roess, Elena S. Prassas, and William R. McShane , Traffic Engineering"", Pearson; 4 edition(July 4, 2010) ISBN-13: 978-0136135739 , ISBN-10: 0136135730

22CE028 AIRPORT DOCKS AND HARBOUR 3 0 0 3

Course Objectives

- To provide a basic knowledge on planning and design of airports.
- To impart a basic knowledge on planning of harbor and its components.
- To impart a basic knowledge on Ports and Coastal structures.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PSO1. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

PSO2. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Planning and functions of airport.
2. Orientation and design of runway
3. Demonstrate the importance of various harbor elements in harbor planning.
4. Planning of Ports and facilities of inland.
5. Understand the concepts of coastal structures and their classifications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	2	1	3								2		2	
3	1	-	3											1
4	1	-	2								2		1	
5	2	1	3											1

UNIT I **9 Hours**

AIRPORT PLANNING AND VISUAL AIDS

Introduction - Airport planning - Standards for planning of airports as per ICAO - Airport site selection - Aircraft characteristics and their impact on planning of an airport - Airport layout - Components of airports - Terminal area - Passenger facilities - Aprons - Hangars - Airport zoning - Air Traffic Control - Airport drainage - Aircraft parking system - Visual aids - Importance of airports in national transportation sector.

UNIT II **9 Hours**

AIRPORT DESIGN AND CONTROL AIDS

Introduction to Airport pavement design - Runway design - Orientation - Geometric design and Correction for gradients - Pattern of Runways - Runway configuration - Taxiway - Factors governing layout of taxiways- Rapid exit taxiways - Separation clearance - Parking and circulation area - Marking and lighting of runway and apron area - Wind and landing direction indicator

UNIT III **9 Hours**

HARBOUR ENGINEERING

Definition of terms - Harbours, ports, docks, tides and waves - Harbours - Site investigation - Planning, requirements and classification - Concept of satellite ports - Docks - Dry and Wet Docks - Dredgers and dredging - Terminal facilities - Shipping terminal facilities - Essentials of passenger terminal- Warehouse - Transit sheds - Mooring accessories - Navigational aids - Piers - Breakwaters - Wharves - Jetties - Quays - Spring fenders - Littoral drift

UNIT IV **9 Hours**

PORT PLANNING AND BUILDING

Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities.

UNIT V **9 Hours**

COASTAL STRUCTURES

Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone-Inland Water Transport - Wave action on Coastal Structures and Coastal Protection Works - Coastal Regulation Zone

Total: 45 Hours

Reference(s)

1. C. JotinKhisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 3rdedition, 2013, ISBN-13: 978-0130335609.
2. L. R. Kadiyali, Traffic and Transportation Planning, Khanna Publishers Ltd., New Delhi, 2017, ISBNNo. 978-81-7409-220-X.
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. C. S. Papacostas and Prevedouros, Transportation Engineering and Planning, Prentice Hall of India,New Delhi, 2013, ISBN-13: 978-0130814197
5. B. G. Hutchinson, Principles of Urban Transportation System Planning, Tata McGraw Hill, 2007

22CE029 TOTAL STATION AND GPS SURVEYING 3 0 0 3

Course Objectives

- To understand the working of Total Station equipment and solve the surveying problems
- To train the students to acquire skill in making precise measurements and obtaining accurate results with Total Station and GPS
- To make students aware with different advance surveying methodologies applied to carry out large scale survey works as modern instruments have largely changed the approach to survey works with the principles being same.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools includingprediction and modelling to complex engineering activities with an understanding of the limitations. PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the principles of topographical map preparation and electronic surveying
2. Propagation of EMR through atmosphere and corrections for its effects
3. Identify the working mechanism and applications of active and passive microwave systems Apply thecontrol point networks and reference systems used with GNSS technology
4. Apply the control point networks and reference systems used with GNSS technology
5. Discuss the practical applications of GPS and the implications of its modernization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1	1								1	2
2	2	2	2	-	-								2	2
3	3	3	3	-									1	1
4	2	2	3		-								2	3
5	3	3	3	3	-								1	3

UNIT I **9 Hours**

FUNDAMENTALS OF TOTAL STATION AND GPS

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Basic concepts of GPS - 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

UNIT II **9 Hours**

ELECTROMAGNETIC WAVES

Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI- Computation of group for light and near infrared waves at standard and ambient conditions- Computation of RI for microwaves at ambient condition -Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -Total atmospheric correction- Use of temperature - pressure transducers

UNIT III **9 Hours**

ELECTRO OPTICAL AND MICRO WAVE SYSTEM

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments- Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments- Comparison between Electro- optical and Microwave system. Care and maintenance of Total Station instruments. Modern positioning systems - Traversing and Trilateration

UNIT IV **9 Hours**

SATELLITE SYSTEM

GPS - Different segments - space, control and user segments - satellite configuration - GPS signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment -GPS receivers

UNIT V **9 Hours**

GPS DATA PROCESSING

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation downloading the data -data processing software modules -solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -basic constellation of satellite geometry & accuracy measures - applications- long baseline processing- use of different softwares available in the market

Total: 45 Hours

Reference(s)

1. Rueger, J.M. "Electronic Distance Measurement", Springer-Verlag, Berlin, 1990
2. Satheesh Gopi, rasathishkumar, madhu N., Advanced Surveying, Total Station GPS and RemoteSensing" Pearson education, 2007

22CE030 REMOTE SENSING AND GIS **3 0 0 3**

Course Objectives

- To deliver the fundamental principles of Remote Sensing and its limitations.
- To impart training on the image Interpretation and Analysis.
- To develop the GIS modeling techniques and applications.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design solutions for complex engineering problems and design system components or processes that meetthe specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the fundamental concepts in Remote sensing.
2. Interpret the data from Images through acquisition, storage, manipulation, analysis and displayof satellite data.
3. Integrate Remote Sensing and GIS to perform raster and vector data analysis.
4. Extrapolate the database concepts of GIS for the development of design specifications for developingand improving the imagery by selecting suitable data models.
5. Apply the principles and concepts of remote sensing and GIS techniques for importantapplications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2		2	1								2	2
3	3	3		3	1								1	2
4	3	3	3	3	1								1	2
5	3	3	-	3	1									1

UNIT I **9 Hours**

FUNDAMENTALS OF REMOTE SENSING

History of remote sensing - Indian Space Programs - Elements of remote sensing - Electromagnetic spectrum - Wavelength regions important to remote sensing - Particle and Wave theory - Stefan-Boltzman and Wein'sLaws - Atmospheric scattering and absorption - Platforms and Sensors.

UNIT II **9 Hours**

IMAGE INTERPRETATION AND ANALYSIS

Concept and types of image interpretation - Basic elements of image interpretation - Visual interpretation keys- Types of Data Products - Digital Image Processing - Pre-processing - Image compression and enhancement techniques - Multispectral Image classification - Supervised and unsupervised.

UNIT III **9 Hours**

GEOGRAPHICAL INFORMATION SYSTEM AND ITS ANALYSIS

GIS definition - Basic components of GIS - Data types - Spatial and non-spatial data - Raster and Vector Data - Analysis and structure of Raster and Vector data - Maps - Map projections - Types of map projections-Concept of GPS and its advantages.

UNIT IV **9 Hours**

DATA INPUT, EDITING AND ANALYSIS

Input methods - Data stream - Data Retrieval - Query Building - Simple Spatial Analysis - Overlay Technique Topological analysis - Modeling surfaces - TIN -DEM - DTM - Slope Model - Integration of Remote Sensingand GIS.

UNIT V **9 Hours**

MAJOR APPLICATIONS OF REMOTE SENSING AND GIS

Natural Resources Management - Land Cover and Land Use - Water Resources and Watershed Management Irrigation and Agriculture - Environmental studies - Groundwater exploration - Wasteland Management -Forest Resources - Natural Disaster Management - Landslides, Flood Routing, Forest Fires,Earthquakes.

Total: 45 Hours

Reference(s)

1. M. Anji Reddy, Remote sensing and Geographical Information Systems, Third Edition, BS Publications, India, 2006.
2. Basudeb Bhatta, Remote Sensing and GIS, Second Edition, Oxford University Press, New Delhi,2017.
3. Kali Charan Sahu, A Text Book of Remote Sensing and Geographical Information Systems, KindleEdition, Atlantic Publishers and Distributers (P) Ltd, New Delhi, 2008.
4. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image interpretation, John Willey and sons,inc. New York, 2002.

22CE031 AIR POLLUTION CONTROL AND MANAGEMENT

3 0 0 3

Course Objectives

- To learn the concept of air pollution and its control measures.
- To understand the sources, types, and effects of air pollution on human health, ecosystems, and the environment.
- To know about the various air pollution control technologies and strategies.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Classify and characterize the various air pollutants and identify their sources.
2. Identify suitable equipment for control of particulate matter.
3. Identify suitable equipment for control of gaseous matter.
4. Choose suitable equipment for air pollution control with respect to emerging trends.
5. Assess the impact on the environment due to air pollution.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-									1	1	1
2	1	3	-									1	1	1
3	1	3										2	1	1
4	1	3	2									3	1	1
5	1	2	2									1	1	1

UNIT I **9 Hours**

INTRODUCTION

Air pollution - Definition and scope - Air quality management - Scales of air pollution - Sources and classification of pollutants and their effect on human health, vegetation and property - Ambient Air Quality and Emission Standards - Meteorology Fundamentals - Dispersion models - Plume behaviour.

UNIT II **9 Hours**

CONTROL OF PARTICULATE MATTERS

Selection of Control equipment - Settling chambers - Filters, gravitational, Centrifugal - multiple type cyclones- prediction of collection efficiency- pressure drop- wet collectors- Fabric Filters- Electrostatic Precipitators - Operational Considerations.

9 Hours

UNIT III

CONTROL OF GASEOUS MATTERS

Selection of control Equipment -Principles of Absorption - Adsorption - Condensation - Incineration - Biological air pollution control technologies - Bio scrubbers -Bio filters.

UNIT IV **9 Hours**

EMERGING TRENDS

Process modification - Automobile air pollution and its control - Fuel modification - Mechanical particulate collectors - Entrainment separation - Internal combustion engines - Membrane process - Ultraviolet photolysis - High efficiency particulate air filters - Technical and economic feasibility of selected emerging technologies for air pollution control - Control of indoor air quality.

UNIT V **9 Hours**

AIR QUALITY MANAGEMENT

Air quality standards - Air quality monitoring - Preventive measures - Air pollution control efforts - Zoning -Town planning regulation of new industries - Legislation and enforcement - Environmental Impact Assessment and Air quality - Air quality management at Delhi -a case study.

Total: 45 Hours

Reference(s)

1. Anjaneyulu .D, "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002.
2. Rao .M.N, and Rao .H. V. N, "Air Pollution Control", Tata-McGraw-Hill, New Delhi, 2006.
3. Rao .C.S, "Environmental Pollution Control Engineering", Wiley Eastern Ltd., New Delhi,2006.
4. Heumann .W.L, "Industrial Air Pollution Control Systems", McGraw-Hill, New Yark, 2007.
5. Mahajan .S.P, "Pollution Control in Process Industries", Tata McGraw-Hill PublishingCompany, New Delhi, 2002.
6. Garg .S.K, "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2005.

22CE032 SOLID WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To emphasize the need integrated municipal solid waste management.
- To provide basic for knowledge about the sources, quantity and characteristic of solid waste.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Characterize the solid waste based on source, type and composition and also emphasize the effectsof its improper disposal.
2. Identify the suitable method for collection, segregation and transportation of solid waste.
3. Learn and analyze the various off site processing techniques for solid waste.
4. Choose the suitable waste disposal methods and apply the waste to energy techniques for solid waste.
5. Categorize biomedical waste and identify a suitable method to collect, treat and dispose it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2					-					1	1	1
2	1	2					-					2	1	1
3	1	3					-					3	1	1
4	2	2											1	1
5	2	2					1						1	1

UNIT I **9 Hours**

FUNDAMENTALS OF SOLID WASTE MANAGEMENT

Solid waste - Scope and importance - Sources and types of solid wastes - Functional elements of solid waste management - Quantity assessment - Generation rate - Factors affecting generation of solid wastes - characteristics - Methods of sampling - Effects of improper disposal of solid wastes - Public awareness; Roleof NGOs; Legal framework regulating municipal solid waste management.

UNIT II **9 Hours**

COLLECTION, SEGREGATION AND TRANSPORTATION OF SOLID WASTE

On-site storage methods - Materials used for containers - On-site segregation of solid wastes - Colour codes -Garbage chutes - Methods of public collection - Selection of location - Requirement of human resources - Types of vehicles - Collection routes - Transfer stations - Operation and maintenance - Options under Indian conditions - Route optimization - Case studies.

UNIT III **9 Hours**

OFF-SITE PROCESSING OF SOLID WASTE

Processing techniques and Equipments: Sorting - Manual and Mechanical - Magnetic Separators - Ballistic method - Eddy Current Separators - Screens for size separation. Volume Reduction - Compaction and Baling; Size Reduction - Shredding - Automatic shredders - Case studies.

UNIT IV **9 Hours**

WASTE CONVERSION TECHNIQUES AND DISPOSAL

Waste to Energy Techniques Composting Aerobic and anaerobic processes Bangalore and Indore processes byproducts Factors affecting composting Merits and demerits Types of composting Incineration, Pyrolysis Merits and demerits. Disposal Mechanisms Open area Dumping Sanitary Land filling Site selection, design and operation of sanitary landfills Methods of sanitary landfills Leachate collection and treatment Fertilizer Residential waste Case studies

UNIT V **9 Hours**

BIOMEDICAL WASTE MANAGEMENT (BMW)

Introduction - Need for safe treatment and disposal of BMW - Colour coding - Types of containers - Categories of Biomedical Waste; Treatment and disposal methods of Biomedical Waste - Biomedical waste management regulations.

Total: 45 Hours

Reference(s)

1. George Tchobanoglous and Frank Kreith, HAndbook of Solid Waste Management, 2nd Edition,McGraw-Hill Publishers, 2002
2. K. Sasikumar and Sanoop Gopi Krishna, "Solid Waste Management" PHI Learning Private Limited,New Delhi, 2013
3. B. Bilitewski, G. HardHe, K. Marek, A. Weissbach, and H. Boeddicker, Waste Management, Springer,2004
4. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development,Government of India, New Delhi, 2016
5. R.E. Landreth and P.A. Rebers, Municipal Solid Wastes problems and Solutions, Lewis Publishers,2020.
6. Bhide A.D. and Sundaresan, B.B., Solid Waste Management in Developing Countries, INSDOC,1993

22CE033 ENVIRONMENTAL IMPACT ASSESSMENT 3 0 0 3

Course Objectives

- To emphasize the need for EIA.
- To provide basic knowledge on the components, methods and quality control measures of EIA.
- To make the students understand the importance of documentation and monitoring of EIA alongwith case studies.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO4 Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal andcultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 Understand the impact of the professional engineering solutions in societal and environmentalcontexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of theengineering practice.
PO9 Function effectively as an individual, and as a member or leader in diverse teams, and inmultidisciplinary settings.
PO10 Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Infer the key features of EIA with reference to legislator aspects in India.
2. Analyse the cost benefits and its alternatives in EIA.
3. Illustrate the impact of the project on environmental issues and its policies.
4. Exemplify the various documentation and report procedures for EIA.
5. Elucidate the public to participate in EIA.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	1		-		-	-	-					1	1
2		2		-		1			1	1			1	1
3	2					2	1	-	2	2			2	2
4	-	-		2		2		1					1	1
5				-		3			2	2			1	1

UNIT I **9 Hours**

INTRODUCTION

Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) - Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Issues in EIA - National, Cross sectoral, Social and cultural Terms of Reference in EIA.

UNIT II **9 Hours**

COMPONENTS AND QUALITY ANALYSIS

Components - Screening - Setting - Analysis - Prediction of impacts - Mitigation - Matrices - Networks - Checklists - Impact Assessment techniques - Cost benefit analysis - Analysis of alternatives; Trends in EIA practice and evaluation criteria - Capacity building for quality assurance - Expert System in EIA - Formats of regulations.

UNIT III **9 Hours**

PREDICTION, ASSESSMENT AND MITIGATION

Methods for Prediction and assessment of impacts on Air, Water, Soil and Noise - Biological, Cultural, Social and Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts - Policies for decision making.

UNIT IV **9 Hours**

DOCUMENTATION AND MONITORING

Document planning - Collection and organization of relevant information - Use of visual display materials - Team writing - Reminder checklists - Environmental monitoring - Guidelines - Policies - Planning of monitoring programmes - Environmental Management Plan -Post project audit.

UNIT V **9 Hours**

PUBLIC PARTICIPATION

Objectives of public participation - Regulatory requirements - Merits and demerits - Conducting public participation - Conflict management - Dispute resolution - Questionnaires for decision making - Public awareness.

Total: 45 Hours

Reference(s)

1. L. W. Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996.
2. Policy Intervention Analysis: environmental Impact Assessment, Ritu Paliwal, Leena Srivastava, The Energy and Resources Institute (TERI), TERI Press, Durbari Seth Block,IHC Complex, Lodhi Road, NewDelhi - 110 003, India, 2014
3. Handbook of Environmental Decision Making in India: An EIA Model (Handbooks Series), O.V.Nandimath, Oxford University Press of India, 2008
4. J. Petts, Handbook of Environmental Impact Assessment Vol. I and II, Blackwell Science, London, 1999.
5. The World Bank Group, Environmental Assessment Sourcebook Vol. I, II and III, The World Bank, Washington, 1991.

22CE034 ENERGY SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on the renewable energy resources
- To introduce the concept of energy source and technology.
- To examine the environmental impacts of different energy systems.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal andcultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 Understand the impact of the professional engineering solutions in societal and environmentalcontexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Identify the sources of energy system and resources
2. Explain the sources of energy, efficiency and their storage
3. Understand the energy efficiency and the environment
4. Select a suitable sustainable civil engineering project connected with energy sources
5. Illustrate the concept of green building

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
1	1					2	3						1	1
2	1					2	-						1	1
3	1					2							2	1
4	1					2	3						2	2
5	1					-	2						1	2

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment

UNIT II **9 Hours**

ENERGY SOURCES

Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil- bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power

projects, superconductor-based energy storages, high efficiency batteries).

UNIT III **9 Hours**

ENERGY AND ENVIRONMENT

Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

UNIT IV **9 Hours**

CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES

Coal mining technologies, Oil exploration offshore platforms, Underground and under sea oil pipelines, Solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems.

UNIT V **9 Hours**

ENGINEERING FOR ENERGY CONSERVATION

Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability.Energy Audit of Facilities and optimization of energy consumption

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems andSustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete GuidetoRenewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set:Mathematics ofDecision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A.(2006) Energy andthe Environment, 2nd Edition, John Wiley
6. E H Thorndike (1976), Energy & Environment: A Primer for Scientists andEngineers, Addison-Wesley Publishing Company

22CE035 INDUSTRIAL WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To provide basic knowledge on the management practices of solid and liquid waste.
- To impart knowledge on the collection, transport and disposal of solid waste.
- To emphasize the need for solid and liquid waste management.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reachingsubstantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3 Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal, and environmental considerations.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Generalize the characteristics of Industrial Waste and their effect on the environment.
2. Identify the suitable wastewater reclamation concepts for reuse, recycle and recovery.
3. Select the suitable treatment technologies for major Industries and their reclamation concept.
4. Compare the treatment and disposal technique based on the characteristics of wastewater.
5. Infer the Hazardous waste and suitable treatment techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-										1	1
2	2	2	-									1	1	1
3	2	2	-										2	2
4	2	3	2										2	2
5	2	3	3									1	2	2

UNIT I **9 Hours**

INTRODUCTION

Types of industries and industrial pollution - Nature and Characteristics of industrial wastes - Population equivalent - Bioassay studies - Effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health - Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II **9 Hours**

POLLUTION FROM MAJOR INDUSTRIES

Sources, Characteristics, waste treatment flow sheets for industries such as Textiles, Tanneries, pharmaceuticals, electroplating industries, dairy, sugar, paper, distilleries, steel plants, refineries, fertilizers, thermal power plants - Wastewater reclamation concepts.

UNIT III **9 Hours**

TREATMENT TECHNOLOGIES

Equalization - Neutralization - Removal of suspended and dissolved organic solids - Chemical oxidation - Adsorption - Removal of dissolved inorganics - Combined treatment of industrial and municipal wastes - Residue management - Dewatering - Disposal.

UNIT IV **9 Hours**

CLEANER PRODUCTION

Waste management Approach - Waste Audit, emission inventories and waste management hierarchy for process industries - Zero discharge - Volume and strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery - Applications. Opportunities and barriers to cleaner technologies; Pollution prevention economics; Waste audits- Material balance approach.

UNIT V **9 Hours**

HAZARDOUS WASTE MANAGEMENT

Hazardous wastes - Sources & characterization - Collection, Segregation - Physio chemical treatment - Solidification - Incineration - Secured landfills - Bioremediation of contaminated sites - Regulatory aspects.

Total: 45 Hours

Reference(s)

1. M.N.Rao, A.K.Dutta, Wastewater Treatment, Oxford - IBH Publication, 1995.
2. W .W. Eckenfelder Jr., Industrial Water Pollution Control, McGraw-Hill Book Company, New Delhi,2000.
3. T.T.Shen, Industrial Pollution Prevention, Springer, 1999.
4. R.L.Stephenson and J.B.Blackburn, Jr., Industrial Wastewater Systems Hand book, Lewis Publisher,New Yark, 1998.
5. H.M.Freeman, Industrial Pollution Prevention Hand Book, McGraw-Hill Inc., New Delhi, 1995.
6. Bishop, P.L., Pollution Prevention: Fundamental & Practice, McGraw-Hill, 2000.

22CE036 HAZARDOUS WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To familiarize the laws and regulations governing hazardous waste storage, transport and treatment.
- To identify environmental concerns for hazardous waste on water, land and air.
- To identify containment technologies and land treatment techniques for hazardous waste.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executinginfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Generalize the characteristics of hazardous waste and their effect on the environment.
2. Characterize the hazardous waste based on source, type and composition and also emphasize theeffects of its improper disposal.
3. Identify the suitable method for collection, segregation and transportation of Hazardous solid waste.
4. Analyze the various off site processing techniques for hazardous waste.
5. Exemplify the suitable waste disposal method for hazardous waste.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2					-					1	1	1
2	1	2					-					2	1	1
3	1	3					-					3	2	2
4	2	2											2	2
5	2	2					1						2	2

UNIT I **9 Hours**

SOURCES OF HAZARDOUS WASTE

Types and Sources hazardous wastes - Need for hazardous waste management - Elements of integrated Hazardous waste management and roles of stakeholders and NGOS - Salient features of Indian legislations on management and handling of hazardous wastes, biomedical wastes, lead acid batteries, E-waste - Case studies.

UNIT II **9 Hours**

CHARACTERIZATION OF HAZARDOUS WASTE

Hazardous waste generation rates and variation - Composition, physical, chemical and biological properties of Hazardous wastes - Hazardous Characteristics - TCLP tests - Waste sampling and characterization plan - Source reduction of wastes - Recycling and reuse - Hazardous Waste Management Rules 2016.

UNIT III **9 Hours**

HANDLING OF HAZARDOUS WASTE

Handling and segregation of wastes at source - Storage and collection Hazardous wastes - Need for transfer and transport - Transfer stations Optimizing waste allocation - Compatibility, storage, labelling and handling of hazardous wastes.

UNIT IV **9 Hours**

PROCESSING OF HAZARDOUS WASTE

Objectives of waste processing - Material separation and processing technologies - Biological and chemical conversion technologies - Thermal conversion technologies and energy recovery - Incineration - Solidification and stabilization of hazardous wastes - Treatment of biomedical wastes and E-waste.

UNIT V **9 Hours**

DISPOSAL OF HAZARDOUS WASTE

Waste disposal options - Disposal in landfills - Landfill Classification- Construction and operation of secured landfills - Bioreactors - Ocean dumping - Land disposal - Soil remediation - Case studies.

Total: 45 Hours

Reference(s)

1. Basic Hazardous waste management, William C.Blackman.Jr, Third Edition, 2016, Lewis Publishers
2. Criteria for hazardous waste landfills-CPCB guidelines 2021.
3. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman,McGraw Hill 1997.
4. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of UrbanDevelopment, Government of India, New Delhi, 2016.
5. Hazardous waste management series (HAZWAMS) - CPCB - Ministry of Environment,Forest and Climate Cahnge - 2022.

22CE037 APPLICATIONS OF NUMERICAL METHODSIN CIVIL ENGINEERING

3 0 0 3

Course Objectives

- Understand the history and basics of numerical methods.
- Understand the application aspects of numerical methods in civil engineering.
- Gain knowledge about the different numerical techniques available.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reachingsubstantiated conclusions using first principles of mathematics, natural sciences, and engineeringsciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-longlearning in the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructuralprojects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Discuss the various methods of solving linear algebraic and transcendental equations.
2. Estimate the intermediate values using interpolation concepts.
3. Interpret the knowledge of numerical differentiations and integration
4. Apply various numerical techniques in solving complex partial differential equations.
5. Apply various numerical techniques in solving complex differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2										1	1	1
2	1	2					1					2	1	1
3	1	3										3	1	1
4	2	2											1	1
5	2	2					1						1	1

UNIT I **9 Hours**

LINEAR ALGEBRAIC EQUATIONS

Method of false position Newtons method Solution of linear system of equations by Gaussian elimination andGauss Jordan methods Iterative methods Gauss Jacobi and Gauss Seidel methods.

UNIT II **9 Hours**

INTERPOLATION

Newtons forward and backward difference formulae Bessels formula Lagranges interpolation formulaNewtons divided difference formula.

UNIT III **9 Hours**

NUMERICAL DIFFERENTIATION

Differentiation Using Newtons forward, backward and divided difference interpolation formula Single step Methods Taylor Series Euler and Modified Euler methods Fourth order RungeKutta method for solving first order equations Multistep methods Milnes and Adams predictor and corrector methods.

UNIT IV **9 Hours**

NUMERICAL INTEGRATION

Trapezoidal rule Simpsons 1/3 Double integrals using Trapezoidal and Simpsons rules

UNIT V **9 Hours**

BOUNDARY VALUE PROBLEMS IN PDE

Finite difference approximations to partial derivatives Two dimensional Laplace equations Poisson equations One dimensional heat equation by implicit and explicit methods One dimensional wave equation.

Total: 45 Hours

Reference(s)

1. Kandasamy, P., Thilakavathy, K. and Gunavathy, K., Numerical Methods, S.Chand & Co, New Delhi,reprint 2010.
2. Venkatraman, M. K, Numerical Methods, National Publishing Company, Chennai, 2000.
3. Balagurusamy, E., Numerical Methods, Tata McGraw-Hill, New Delhi, 1999.
4. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., Numerical Methods for Scientific and Engineering Computation, Fourth Edition, New Age International (P) Ltd., New Delhi, 2006.
5. Sankara Rao, K., Numerical Methods for Scientists and Engineers, Second Edition, Prentice HallIndia, New Delhi, 2004.

22CE038 APPLICATION OF PYTHON FOR CIVIL ENGINEERING

3 0 0 3

Course Objectives

- Understand the history and basics of python.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing infrastructuralprojects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide range of CivilEngineering problems with innovative research attributes.

Course Outcomes (COs)

1. Implement simple python programs using input output operations.
2. Develop python programs using expressions and statements.
3. Implement python programs using control flow statements and strings.
4. Apply the concepts of functions and files in python programming.
5. Design applications using list, sets, tuples and dictionaries in python.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2										1	1	1
2	1	2										2	1	1
3	1	3					2					3	1	1
4	2	2	-										1	1
5	2	2					1						1	1

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language,algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif- else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated forPython 3, Shroff/O"Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expandedEdition, MIT Press , 2017

22CE039 INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING **3 0 0 3**

Course Objectives

- To provide students with a comprehensive understanding of instrumentation principles relevant tocivil engineering applications.
- To enable students to apply instrumentation effectively in civil engineering projects.
- To enable students to apply sensor technologies effectively in civil engineering projects.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executingInfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Summarize various performance characteristics of instruments and the quality of measurement.
2. Interpret the type of transducer based on the transduction principles.
3. Identify the relevant transducer for measurement of physical quantities.
4. Discover the additional attributes in advanced sensors and their role in Civil Engineering.
5. Discover the use of digital transducers in Civil Engineering projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2										1	1	1
2	1	2										2	1	1
3	1	3										3	1	1
4	2	2										1	1	1
5	2	2										1	1	1

UNIT I **9 Hours**

INTRODUCTION

Definition of sensor transducer Block Diagram elements of measurement system classification of sensors transducers static characteristics accuracy precision resolution linearity, sensitivity, range, loading effect, threshold,dead time, dead zone, span.Errors in measurement True value, static error, static correction, scale range and scale span, error calibration curve, readability, repeatability & reproducibility, drift and noise

UNIT II **9 Hours**

RESISTIVE TRANSDUCERS

Potentiometers-Linear POT, Rotary POT, characteristics of POT. Thermistors- Construction and its Resistance-Temperature characteristics. Thermocouples- Construction and its Resistance-emf characteristicsinductive transducers-Principle of change of self inductance, Principle of change of mutual inductance, Linear variable differential transformer(LVDT), Rotary variable differential transformer(RVDT).

UNIT III **9 Hours**

CAPACITIVE TRANSDUCERS

Introduction-Variable area type-variable air gap type- differential arrangement in capacitive transducers, variation of dielectric constant for measurement of liquid level, variation of dielectric constant for measurement of displacement, advantages & disadvantages of Capacitive transducers.

Piezoelectric transducers- Measurement of Force, Modes of operation of piezoelectric crystals, properties of piezoelectric crystals, use of Piezoelectric Transducers.

UNIT IV **9 Hours**

HALL EFFECT TRANSDUCERS

Hall effect element, Measurement of displacement, current and power. Optical Transducers Vacuum photo emissive cell and its characteristics, semi conductor photo electric transducer- Photo conductive cell and its characteristics, photo diode and its characteristics, photovoltaic cell and its characteristics.

UNIT V **9 Hours**

DIGITAL AND SMART SENSORS

Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Civil Engineering

Total: 45 Hours

Reference(s)

1. A.K.Ghosh, Introduction to Measurements & Instrumentation, IIIrd edition, PHI
2. A.K.Sawhney & Puneet Sawhney, A Course in Mechnanical Measuremnets & Instrumentation,Dhanapat Rai & Co.
3. D.V.S.Murty, Transducers & Instrumentation, PHI.

22CE040 APPLICATION OF MATLAB FOR CIVIL ENGINEERING

3 0 0 3

Course Objectives

- Understand the history and basics of matlab.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executingInfrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Implement simple MATLAB programs using input output operations.
2. Develop MATLAB programs using expressions and statements.
3. Implement MATLAB programs using control flow statements and strings.
4. Apply the concepts of functions and files in matlab programming.
5. Design applications using list, sets, tuples and dictionaries in matlab.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2										1	1	1
2	1	2										2	1	1
3	1	3					2					3	1	1
4	2	2											1	1
5	2	2					1						1	1

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language,algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

MATLAB interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif- else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated forPython 3, Shroff/Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expandedEdition, MIT Press , 2017

22CE041 APPLICATION OF R PROGRAMMING IN CIVIL ENGINEERING

3 0 0 3

Course Objectives

- Understand the history and basics of R Programming.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-longlearningin the broadest context of technological change.

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executingInfrastructural projects ensuring safety, cost-effectiveness and sustainability.

PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Implement simple R Programming programs using input output operations.
2. Develop R Programming programs using expressions and statements.
3. Implement R Programming programs using control flow statements and strings.
4. Apply the concepts of functions and files in R Programming programming.
5. Design applications using list, sets, tuples and dictionaries in R Programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2										1	1	1
2	1	2										2	1	1
3	1	3										3	1	1
4	2	2					2						1	1
5	2	2					1						1	1

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language,algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

R Programming interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif- else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated forPython 3, Shroff/Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expandedEdition, MIT Press , 2017

22CE042 RISK ASSESSMENT AND SAFETY MANAGEMENT

3 0 0 3

Course Objectives

- Understand the history risk assessment and safety measures need for civil engineers.
- Gain knowledge about the different techniques available for predicting risk and safety measures.
- To explore the various risk and safety management for successful completion of Constructionprojects.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5 Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding ofthe limitations.
PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life-long
PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing Infrastructural projects ensuring safety, cost-effectiveness and sustainability.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a widerange of Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Select the basics risk assessment for industrial safety and health
2. Identify hazards and its remedial measures in the construction industry
3. Identify the safety measures in handling construction equipments
4. Indicate the importance of environmental safety and the role of individual in prevention Ofpollution
5. Illustrate fire safety installation and maintenance of sprinkler installation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3						2	1	1
2	3	2				1						2	1	1
3	3				2	3						1	1	1
4	2				1	3						2	1	1
5	2	1				3						1	1	1

UNIT I **9 Hours**

INTRODUCTION

Risk assessment and control- Legal Basis for Risk Assessment - Hazards, remedial measures -
Safety and health policy- Motivation of employees - Workplace Precautions - Management responsibilities, Individual responsibilities - Training for Safety and Health- Insurance coverage of Industrial plant & personnel.

UNIT II **9 Hours**

CONSTRUCTION SAFETY CONSTRUCTION SAFETY

Quality and Safety Concerns in Construction -Organizing for Quality and Safety - Work and MaterialSpecifications - Importance of Safety during project construction - Accidents and their Causes - General precaution to hazardous atmosphere and materials - Safety facilities at construction sites - Training to project staff and operation staff - Emergency rescue equipment - Costs of Construction Injuries - Legal Implications.

UNIT III **9 Hours**

SAFETY MEASURES IN HANDLING CONSTRUCTIONEQUIPMENTS

General requirements of safety in concrete construction Handling of Concrete forms and shoring Safety measures for hoisting and erection of prefabricated elements OSHA (Occupational Safety and Healthy Administration) for Prestressing Operations Risk Assessment for erecting RC & Steel members Electrical safety in construction site.

UNIT IV **9 Hours**

ENVIRONMENTAL SAFETY

Scope and Importance of Environmental safety- Environmental impact assessment (EIA) - Environmental pollution - Sustainable development- Global warming, greenhouse effect, urbanization
- Role of Government in environment protection- National Committee on environmental Planning (NCP)- Environmental Appraisal Committee (EAC) - Role of individual in prevention of pollution

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Fire extinguishing appliances -Selection requirements, installation and maintenance - Sprinkler system - Maintenance of sprinkler installation - Pressure gauges, Installation of control valves - Fire protection requirements for buildings and riser system- Fire alarm Systems, Manually operated fire alarms - Smoke detectors, Fire extinguishing appliances in multi storied buildings, hotels etc.

Total: 45 Hours

Reference(s)

1. Risk assessment- A Practical Guide, 1993, Institution of Occupational SafetyandHealth, UnitedKingdom
2. Rao.S and Saluja H.L., Electrical Safety, Fire Safety Engineering and SafetyManagement, KhannaPublishers, first edition, 1998
3. Grundy. J. ,Construction Technology, Viva Books Pvt. Ltd., 2006
4. R.K. Jain & Sunil S. Rao, Industrial safety health and environment Managementsystem, KhannaPublishers, Secondedition, 2008
5. V.K. Jain, New Age International Publishers, 2nd Edition, First Print 1996 Re-print 2000

22OCE01 ENERGY CONSERVATION AND MANAGEMENT 3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings and
- To utilize the available resources in optimal ways

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specializationto the solution of complex engineering problems.
PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.
PO12 Recognize the need for, and have the preparation and ability to engage in independent and life- longlearning in the broadest context of technological change.
PSO2 Graduates will be able to implement various software tools and smart technologies to solve a wide rangeof Civil Engineering problems with innovative research attributes.

Course Outcomes (COs)

1. Classify and characterize the energy resources.
2. Illustrate the concept of green building.
3. Outline the sustainable construction practices.
4. Understand the hydropower production and conservation of water.
5. Emphasis the significance of energy and resource recovery from waste materials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-										1		
2	1	2					2					1		1
3	1	2					2					1		1
4	1	2					2					1		1
5	1	2					2					1		1

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment.Energy - Past & Present scenario of World; Renewable and Nonrenewable energy resources

UNIT II **9 Hours**

ENERGY CONSERVATION IN BUILDINGS

Principles of Planning of buildings: orientation, energy efficiency, utility. Components of building- classification of buildings. Green building - LEED building assessment standard – LEED certification process - Building rating system - Building energy issues – Building energy design strategies – Energy Auditing

UNIT III **9 Hours**

SUSTAINABLE CONSTRUCTION

Equipment use in excavations, foundation, concreting. Advanced Techniques in tunneling, under water construction, piling techniques, Innovations & efficiency in Highways, Railways & Harbours - linkages between economic and environmental outcomes

UNIT IV **9 Hours**

WATER CONSERVATION & SUSTAINABILITY

Types of reservoirs and its functions – Hydropower production – Types of Turbines & selections of turbines & Energy calculations. Water losses from reservoirs and channels – Canal lining & its economic aspects. Water supply systems & Irrigation methods - Rain Water Harvesting methods & benefits.

UNIT V **9 Hours**

ENERGY RECOVERY FROM WASTE

Classification and sources of wastes- Factors affecting MSW generation – Waste management hierarchy - Energy recovery from wastes: Thermochemical methods for energy production - Details of incineration, gasification and pyrolysis & biochemical conversions - Landfill gas recovery system - Principles of fermentation - Concept of MFC - Trans-esterification process - Biofuel processing - Biomass gasification-Organic waste for hydrogen production.

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
2. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley &Sons, Inc., New Jersey, 2008.
3. H. M. Raghunath, Irrigation Engieering, Wiley India (P) Ltd, 2011
4. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
5. M. Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, ISBN-10: 8173191409,1997.
6. Lal, P.M. Sarma, Priyangshu M, Wealth from Waste: Trends and Technologies, 3rd Edition, The Energy and Resources Institute, New Delhi, ISBN: 9788179934241, 2011.
7. W. McDonough, M. Braungart, Cradle to Cradle: Remaking the Way We Make Things, United States: North Point Press, ISBN-10: 0865475873, 2002.

22OEI04 OPTOELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor applications

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	3	2	1	2										
3	3	2	1											
4	3	2	2	2										
5	3	2	2	2										

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties- Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

UNIT II **9 Hours**

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non- destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

Total: 45 Hours

Reference(s)

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India,2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment inorder to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO6 Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply thee bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio- refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1		3	3								1
2	2	2	2	2		1	1								3
3	1	1	1	1		3	3								2
4	2	2	2	2		3	3								3
5	1	1	1	1		1	1								

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative andthermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purificationof glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology,McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer,2007

22OPH01 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	1							1		
2	3	2	2	1	1							1		
3	3	2	2	1	1							1		
4	3	2	2	1	1							1		
5	3	2	2	1	1							1		

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction - Feynman's vision - national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures - effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD - chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nanotubes- structure, synthesis and electrical properties – applications - quantum well laser - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS) - fabrication, actuators-organic FET-principle, description, requirements, integrated circuits- single electron transistor - organic photovoltaic cells - spintronics

Total: 45 Hours

Reference(s)

1. W A Goddard and D W Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012
2. Charles P Poole, Jr and Frank J Owens, Introduction to Nanotechnology, Wiley Interscience, 2007
3. Guozhong Cao, Y Wang, Nanostructures and Nanomaterials-Synthesis, Properties & Applications, Imperials College Press, 2011
4. T Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012
5. Robert W Kelsall, Ian W Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, Fuel cells: Principles and Applications, University Press, 2009

.

22OPH02 - SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	1							1		
2	3	2	2	1	1							1		
3	3	2	2	1	1							1		
4	3	2	2	1	1							1		
5	3	2	2	1	1							1		

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor.

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM.

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells – efficiency.

Total: 45 Hours

Reference(s)

1. Donald A Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 2012
2. S M Sze and M K Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015
3. Ben G Streetman and S K Banerjee , Solid State Electronic Devices, Pearson Education Ltd, 2015
4. C Kittel, Introduction to Solid State Physics, John-Wiley & Sons, 2012
5. J Millman and C Halkias, Electronic Devices and Circuits, Tata McGraw Hill, 2010
6. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006

22OPH03 - APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1								1		
2	3	2	2	1								1		
3	3	2	2	1								1		
4	3	2	2	1								1		
5	3	2	2	1								1		

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator.

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO_2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K Thiyagarajan and A K Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015
2. M N Avadhanulu, An Introduction to Lasers Theory and Applications, S. Chand Publisher, 2013
3. W Koechner, M Bass, Solid State Lasers: a graduate text, Springer Verlag, New York, 2006
4. K P R Nair, Atoms, Molecules and Lasers, Narosa Publishing House, 2009
5. K R Nambiar, Lasers: Principles Types and Applications, New Age International Publications, 2006
6. A. Sennaroglu, Solid-State Lasers and Applications, CRC Press, 2006

22OPH04 - BIOPHOTONICS 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2	1									
2	2	3	2	2	1									
3	3	3	2	2	1									
4	4	3	2	2	1									
5	5	3	2	2	1									

Unit I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles - Coherence of light - lasers - classification of lasers - Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

Unit II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues - Light – TissueInteractionVariables - Light - Tissue Interaction Theory: Radiative Transport Theory - Photo process in biopolymers - In Vivo Photo excitation - photo-induced physical, chemical, thermal and mechanical effects in biological systems - Optical biopsy - Single molecule detection

Unit III **9 Hours**

BIONANO PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing - Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors– biomaterials for photonics - Principle and design of laser tweezers - laser trapping and dissection for biological manipulation.

Unit IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra - the therapeutic window, Light penetration intissues - Absorbing agents in tissues and blood - Skinoptics, response the UV radiation, Optical parameter soft issues - tissue welding - tissue contouring - tissuere generation - Femto laser surgery - low level light therapy and photo dynamic therapy

Unit V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging - Fluorescence Microscopy - Scanning Microscopy - Invivo Confocal Microscopy - Multi photon Microscopy - Optical Coherence Tomography (OCT) - Fluorescence Resonance Energy Transfer (FRET) imaging - fluorescence lifetime imaging Microscopy (FLIM) - Nonlinear optical imaging - Coherent Anti - stokes Raman Scattering - Bioimaging Applications.

LASER SAFETY (only Self-study purpose not for the course credit)

Laser radiation hazards including effects on the eye and skin, Maximum Permissible exposure (MPE), Laser Hazard classification

Reference(s)

1. Paras N Prasad, Introduction to Biophotonics, Wiley Inter-science, A John Wiley & Sons, Inc., Publication, 2003
2. Andrew GWebb, Introduction to Biomedical Imaging, IEEE Press, 2002
3. Lihong V Wang and HSin-i Wu, Biomedical Optics: Principles and Imaging, Wiley2007
4. R Splinter and B A Hooper, An Introduction to Biomedical Optics, Wiley Inter science , Taylor & Francis, 2007
5. D E Chandler and R W Roberson, Bioimaging Current Concepts in Light and Electron Microscopy, Jones and Bartlett publishers, 2008
6. Peter Torok and Fu-Jen Kao, Optical Imaging and Microscopy: Techniques and Advanced Systems, Springer, 2004

22OPH05 - PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supra molecules
- To summarize the soft matter properties of structures and components of life

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2	2												
5	2	2												

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid - Newtonian liquid - visco elasticity. Glasses: relaxation time – viscosity - glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces - steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation - strong colloids - weak colloids. Physical and chemical gels-classical theory of gelation - elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases - distortions and topological defects - electrical and magnetic properties - polymer liquid crystals - Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation - types of micelles - bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life - Nucleic acids - proteins - interaction between proteins – polysaccharides - membranes

Total: 45 Hours

References

1. Richard A L Jones, Soft Condensed Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013
3. Ian W Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. Fernandez-Nieves A and Puertas A M, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, and Oleg D Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003

22OCH01 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (>100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosionin new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirectdamage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams ofMg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, Introduction to Corrosion Engineering, Create Space Independent Publishing Platform, 1st Edition, 2016.
2. E. McCafferty, Introduction to Corrosion Science, Springer, 1st Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2nd Edition, 2008.
5. David E.J. Talbot and James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press, 2nd Edition, 2007.

22OCH02 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and syntheticpolymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co- ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwellhardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International (P) Ltd, New Delhi, 2021.
2. Joel R. Fried, Polymer Science and Technology, Prentice Hall of India (P). Ltd., 2014.
3. R. J. Young and P. A. Lovell, Introduction to Polymers, CRC Press, New York, 2011.
4. F. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, New York, 2008.
5. Barbara H. Stuart, Polymer Analysis, John Wiley & Sons, New York, 2008.
6. George Odian, Principles of Polymerization, John Wiley & Sons, New York, 2004.

22OCH03 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7 Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteriesand infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3					1							
3	3	1												
4	2	2					1							
5	3	3					1							

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium,and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. S.P. Jiang and Q. Li, Introduction to fuel cells, Springer, 2021.
2. M.M. Eboch, The Future of Energy: From solar cells to flying wind farms, Capstone publishers, 2020.
3. N. Eliaz and E. Gileadi, Physical electrochemistry, fundamentals, techniques and applications, Wiley, 2019.
4. J. Garche and K. Brandt, Electrochemical power sources: Fundamentals systems and applications, Elsevier, 2018.
5. A. Iulianelli and A. Basile, Advances in hydrogen production, storage and distribution, Elsevier, 2016.

22OMA01 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science &Engineering
- It introducesthe structuressuch as graphs& trees and techniquesof counting and combinations, whichare needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2 Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2													
2	1	3													
3	2	3													
4	2	3													
5	3	3													

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1- Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations withrepetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hallof India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley,1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									2		2				

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

UNIT II **9 Hours**

PLANNING

Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**

ORGANISING

Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management

UNIT IV **9 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective communication-Communication and IT.

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and MamataMohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

22OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Programme Outcomes (POs)

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act-Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance – functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Programme Outcomes (POs)

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute - NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html