



ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.E. SAFETY AND FIRE ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1	Have a sound knowledge in Safety and Fire Engineering aspects to provide solutions for Potential hazards
PEO2	Expertise in the area of Thermal, Chemical Reactions, Structural Stability, Environmental Impacts
PEO3	Practice their Professions through evaluation, communications, ethics and social responsibility

PROGRAM COURSE OUTCOMES (POs):

PO#	Graduate Attribute
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	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.
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
4	Conduct investigations of complex problems: 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	Modern tool usage: 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	The engineer and society: 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	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	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.
11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Analyse and assess fire safety of buildings and industries to design and specify fire protection systems.
PSO2	Assess hazards and risks in process and manufacturing industries and devise remedial measures and safety management systems.
PSO3	Assess the occupational health and environmental issues associated with industrial and other activities to design control measures with traditional and modern computational tools based on codes and statutes.

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	3	2	3	2	2	2	1	1	1	1	1	3	3	2	1
II.	2	3	2	3	3	1	3	2	2	2	3	2	1	3	2
III.	1	1	1	1	1	3	2	3	3	3	2	1	2	1	3

PROGRESS THROUGH KNOWLEDGE

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CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	அறிவியல் தமிழ் /Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICAL								
7	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9	GE3172	English Laboratory [§]	HSMC	0	0	2	2	1
TOTAL				16	1	10	27	22

[§] Skill Based Course

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODSPER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3251	Materials Science	BSC	3	0	0	3	3
4.	BE3251	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.		NCC Credit Course Level 1 [#]	-	2	0	0	2	2
7.	GE3252	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	BE3271	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language [§]		0	0	4	4	2
TOTAL				14	1	16	31	23

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

[§] Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	ME3351	Engineering Mechanics	ESC	3	0	0	3	3
3.	CE3391	Fluid Mechanics and Machinery	ESC	3	1	0	4	4
4.	SF3301	Principles of Safety Management	PCC	3	0	0	3	3
5.	SF3302	Electrical Technology and Safety	PCC	3	0	0	3	3
6.	SF3303	Principles of Chemical Engineering	PCC	3	0	0	3	3
PRACTICALS								
7.	SF3311	Electrical Technology Laboratory	PCC	0	0	4	4	2
8.	GE3361	Professional Development [§]	EEC	0	0	2	2	1
TOTAL				18	2	6	26	23

[§] Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3352	Probability and Linear Algebra	BSC	3	1	0	4	4
2.	SF3401	Occupational Health and Hygiene	ESC	3	0	0	3	3
3.	CE3491	Strength of Materials	PCC	3	0	0	3	3
4.	SF3402	Fire Engineering and Protection	PCC	3	0	0	3	3
5.	SF3403	Safety in Construction	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2 [#]		3	0	0	3	3 #
PRACTICALS								
8.	SF3411	Industrial Hygiene Laboratory	PCC	0	0	4	4	2
9.	CE3481	Strength of Materials and Fluid Machinery Laboratory	PCC	0	0	4	4	2
TOTAL				17	1	8	26	22

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

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ME3393	Manufacturing Processes	PCC	3	0	0	3	3
2.		Professional Elective I	PEC	-	-	-	-	3
3.		Professional Elective II	PEC	-	-	-	-	3
4.		Professional Elective III	PEC	-	-	-	-	3
5.		Professional Elective IV	PEC	-	-	-	-	3
6.		Mandatory Course-I ^{&}	MC	3	0	0	3	0
PRACTICALS								
7.	ME3382	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
8.	SF3511	Computer Aided Design Laboratory	PCC	0	0	4	4	2
TOTAL				-	-	-	-	19

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MCI)

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	SF3601	Chemical Technology and Reaction Engineering	ESC	3	0	0	3	3
2.		Open Elective – I [*]	OEC	3	0	0	3	3
3.		Professional Elective V	PEC	-	-	-	-	3
4.		Professional Elective VI	PEC	-	-	-	-	3
5.		Professional Elective VII	PEC	-	-	-	-	3
6.		Professional Elective VIII	PEC	-	-	-	-	3
7.		Mandatory Course-II ^{&}	MC	3	0	0	3	0
8.		NCC Credit Course Level 3 [#]		3	0	0	3	3
PRACTICALS								
9.	SF3611	Unit Operations Laboratory	PCC	0	0	4	4	2
TOTAL				-	-	-	-	20

^{*}Open Elective – I shall be chosen from the emerging technologies.

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MCI)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII / VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	SF3701	Transportation Systems and Safety	PCC	3	0	0	3	3
2.	SF3702	Human Factors Engineering	PCC	3	0	0	3	3
3.		Human Values and Ethics	HSMC	2	0	0	2	2
4.		Elective – Management	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	SF3711	Industrial Training (Fire Safety)	PCC	0	0	4	4	2
9.	SF3712	Fire Engineering Laboratory	PCC	0	0	4	4	2
TOTAL				20	0	8	28	24

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**Open Elective – II shall be chosen from the emerging technologies.

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes)

Elective - Management shall be chosen from the elective Management courses

SEMESTER VIII / VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	SF3811	Project Work / Internship	EEC	0	0	20	20	10
TOTAL				0	0	20	20	10

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

TOTAL CREDITS: 163

ELECTIVE - MANAGEMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3752	Principles of Management	HSMC	3	0	0	3	3
2.	GE3753	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3754	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3755	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3756	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3757	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES:VERTICALS				
VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5
MANAGEMENT AND SAFETY STANDARD	FIRE SAFETY SYSTEMS	HEALTH AND RADIATION SAFETY	SAFETY IN INDUSTRIES	ENVIRONMENTAL SAFETY ENGINEERING
Industrial Engineering	Fire Engineering	Food and Industrial Bio Safety	Facility Layout and Safety in Material Handling	Disaster Management
Safety Management	Fire Risk Analysis and Accident Investigation	Legal Aspects of Health Safety and Environment	Process Instrumentation and Control	Environmental Protection and Waste Management
Advanced Safety Engineering and Management	Fire Fighting Installation and Automation	First Aid and Emergency Procedures	Ergonomics in Design	Air and Water Pollution control and regulations
Foundation Skills in Integrated Product Development	Fire Fighting & Safety Equipments	Medical Waste Management	Safety Aspects of Integrated Product Development	Energy Environment Ethics and Society
Hazard Analysis and Risk Assessment	Fire Prevention and Protection Measures	Heat and Mass Transfer	Safety in Engineering Industry	Epidemic control and Modelling
Hazard Control in Manufacturing Industry	Design of Fire Fighting and Protection System	Radiation Protection	Safety in Petroleum and Petrochemical Industries	Remote Sensing in Environmental safety
Advanced safety systems in Industry	Building Fire and Smoke Dynamics	Nuclear Safety and Radioactive and Radioactive material	Safety in Construction Industry and Town Planning	Rescue Equipment and Techniques
Fire Safety Codes and Standardization	Explosive Technology and Safety	Thermal and Fired Equipment design	Safety in Automotive design and Control	Atmospheric Ground and Ocean Dispersion

Registration of Professional Elective Courses from Verticals:

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

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

VERTICAL 1: HAZARD MANAGEMENT AND SAFETY STANDARD

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	SF3001	Industrial Engineering	PEC	3	0	0	3	3
2	SF3002	Safety Management	PEC	3	0	0	3	3
3	SF3003	Advanced Safety Engineering and Management	PEC	3	0	0	3	3
4	SF3004	Foundation Skills in Integrated Product Development	PEC	3	0	0	3	3
5	SF3005	Hazard Analysis and Risk Assessment	PEC	3	0	0	3	3
6	SF3006	Hazard Control in Manufacturing Industry	PEC	3	0	0	3	3
7	SF3007	Advanced safety Systems in Industry	PEC	3	0	0	3	3
8	SF3008	Fire Safety Codes and Standardization	PEC	3	0	0	3	3

VERTICAL 2 : FIRE SAFETY SYSTEMS

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	SF3009	Fire Engineering	PEC	3	0	0	3	3
2	SF3010	Fire Risk Analysis and Accident Investigation	PEC	3	0	0	3	3
3	SF3011	Fire Fighting Installation and Automation	PEC	3	0	0	3	3
4	SF3012	Fire Fighting & Safety Equipments	PEC	3	0	0	3	3
5	SF3013	Fire Prevention and Protection Measures	PEC	3	0	0	3	3
6	SF3014	Design of Fire Fighting and Protection System	PEC	3	0	0	3	3
7	SF3015	Building Fire and Smoke Dynamics	PEC	3	0	0	3	3
8	SF3016	Explosive Technology and Safety	PEC	3	0	0	3	3

VERTICAL 3: HEALTH AND RADIATION SAFETY

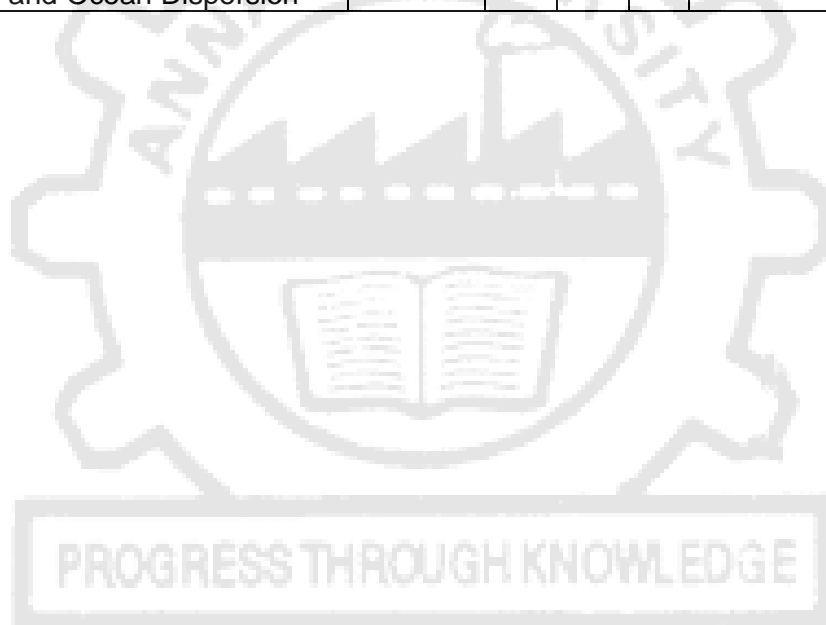
Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	SF3017	Food and Industrial Bio Safety	PEC	3	0	0	3	3
2	SF3018	Legal Aspects of Health Safety and Environment	PEC	3	0	0	3	3
3	SF3019	First Aid and Emergency Procedures	PEC	3	0	0	3	3
4	SF3020	Medical Waste Management	PEC	3	0	0	3	3
5	ME3691	Heat and Mass Transfer	PEC	3	0	0	3	3
6	SF3022	Radiation Protection	PEC	3	0	0	3	3
7	SF3023	Nuclear Safety and Radioactive and Radioactive material	PEC	3	0	0	3	3
8	CME357	Thermal and Fired Equipment design	PEC	3	0	0	3	3

VERTICAL 4: SAFETY IN INDUSTRIES

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	SF3024	Facility Layout and Safety in Material Handling	PEC	3	0	0	3	3
2	SF3025	Process Instrumentation and Control	PEC	3	0	0	3	3
3	CME342	Ergonomics in Design	PEC	3	0	0	3	3
4	SF3026	Safety Aspects of Integrated Product Development	PEC	3	0	0	3	3
5	SF3027	Safety in Engineering Industry	PEC	3	0	0	3	3
6	SF3028	Safety in Petroleum and Petrochemical Industries	PEC	3	0	0	3	3
7	SF3029	Safety in Construction Industry and Town Planning	PEC	3	0	0	3	3
8	SF3030	Safety in Automotive design and Control	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENTAL SAFETY ENGINEERING

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	CSF331	Disaster Management	PEC	3	0	0	3	3
2	SF3031	Environmental Protection and Waste Management	PEC	3	0	0	3	3
3	SF3032	Air and Water Pollution control and regulations	PEC	3	0	0	3	3
4	SF3033	Energy Environment Ethics and Society	PEC	3	0	0	3	3
5	SF3034	Epidemic control and Modelling	PEC	3	0	0	3	3
6	SF3035	Remote Sensing in Environmental safety	PEC	3	0	0	3	3
7	SF3036	Rescue Equipment and Techniques	PEC	3	0	0	3	3
8	SF3037	Atmospheric Ground and Ocean Dispersion	PEC	3	0	0	3	3



OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.)

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OAS352	Space Engineering	OEC	3	0	0	3	3
11.	OIM351	Industrial Management	OEC	3	0	0	3	3
12.	OIE354	Quality Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3

17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
25.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
26.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
27.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OEC351	Signals and Systems	OEC	3	0	0	3	3
35.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
36.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
37.	OBM352	Assistive Technology	OEC	3	0	0	3	3
38.	OMA352	Operations Research	OEC	3	0	0	3	3
39.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
40.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
12.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
13.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
14.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
15.	OAS353	Space Vehicles	OEC	3	0	0	3	3
16.	OIM352	Management Science	OEC	3	0	0	3	3
17.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
18.	OIE353	Operations Management	OEC	3	0	0	3	3
19.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
20.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
21.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
22.	OMR353	Sensors	OEC	3	0	0	3	3
23.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
24.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
25.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
26.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3

27.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
28.	OAE353	Drone Technologies	OEC	3	0	0	3	3
29.	OGI352	Geographical Information System	OEC	3	0	0	3	3
30.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
31.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
32.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OCH353	Energy Technology	OEC	3	0	0	3	3
35.	OCH354	Surface Science	OEC	3	0	0	3	3
36.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
37.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
38.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
39.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
40.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
41.	OTT355	Fibre Science	OEC	3	0	0	3	3
42.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
43.	OPE353	Industrial safety	OEC	3	0	0	3	3
44.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
45.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
46.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
47.	OEC353	VLSI Design	OEC	3	0	0	3	3
48.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
49.	OBM353	Wearable devices	OEC	3	0	0	3	3
50.	OBM354	Medical Informatics	OEC	3	0	0	3	3

B.E. SAFETY AND FIRE ENGINEERING

	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII/VIII	VII/VIII	
1.	HSMC	5	3					5		13
2.	BSC	12	7	4	6					29
3.	ESC	5	11	7	3		3			29
4.	PCC			11	13	7	2	10		43
5.	PEC					12	12			24
6.	OEC						3	9		12
7.	EEC		2	1					10	13
8.	Mandatory Course (Non credit)					✓	✓			
		22	23	23	22	19	20	24	10	
Total										163



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

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In addition to the all the verticals of other programmes)

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

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	CMG338	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurship	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

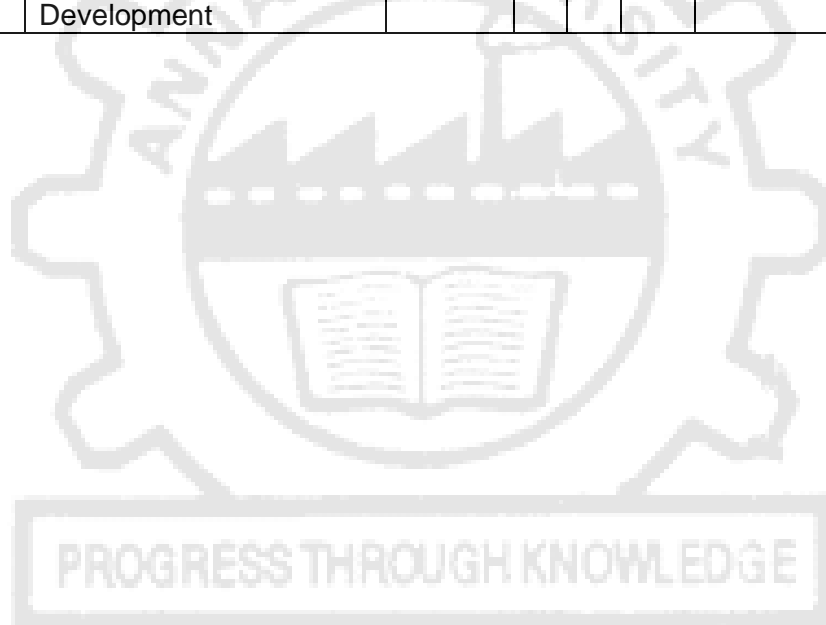
VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics for Management	PEC	3	0	0	3	3
2.	CMG350	Datamining for Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3



OBJECTIVES

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS**9+3**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES**9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**9+3**

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS**9+3**

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS**9+3**

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS**OUTCOMES:**

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

ME3351**ENGINEERING MECHANICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- 1 To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- 2 To introduce the equilibrium of rigid bodies , vector methods and free body diagram
- 3 To study and understand the distributed forces, surface, loading on beam and intensity.
- 4 To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
- 5 To develop basic dynamics concepts – force, momentum, work and energy;

UNIT I STATICS OF PARTICLES**9**

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

UNIT II EQUILIBRIUM OF RIGID BODIES**9**

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

UNIT III DISTRIBUTED FORCES**9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION**9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES**9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL : 45 PERIODS**OUTCOMES:**

At the end of the course the students would be able to

1. Illustrate the vector and scalar representation of forces and moments
2. Analyse the rigid body in equilibrium
3. Evaluate the properties of distributed forces
4. Determine the friction and the effects by the laws of friction
5. Calculate dynamic forces exerted in rigid body

TEXTBOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2							2	3	1	1
2	3	2	2	1	2							2	3	1	1
3	3	2	3	1	2							2	3	1	2
4	3	2	3	1	2							2	3	1	2
5	3	2	3	1	2							2	3	1	2
Low (1) ; Medium (2) ; High (3)															

COURSE OBJECTIVES:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS**10+3**

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER**9+3**

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES**8+3**

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

UNIT IV TURBINES**9+3**

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V PUMPS**9+3**

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS**OUTCOMES:**

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

1. Understand the properties and behaviour in static conditions. Also to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCES:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2	2	1	2	1	1	2	3	2	3
2	3	3	3	2	1	2	2	1	2	1	1	2	3	2	3
3	3	3	3	3	1	2	2	1	2	1	1	2	3	3	3
4	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
5	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
Low (1) ; Medium (2) ; High (3)															

SF3301

PRINCIPLES OF SAFETY MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Understanding of the principles of safety management.
2. Enable the students to learn about various functions and activities in organization
3. Enable students to conduct safety audit and write audit report effectively in auditing situations.
4. Have knowledge about sources of information for safety promotion and training.
5. Familiarize students with evaluation of safety performance.

UNIT I INTRODUCTION AND NEEDS OF SAFETY**9**

Introduction-Safety-Goals of safety engineering. Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation.

UNIT II SAFETY ORGANIZATION INTRODUCTION**9**

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer- responsibilities, authority. Safety committee-needs, types, advantages. Accident prevention Methods-Engineering, Education and Enforcement

UNIT III SAFETY EDUCATION AND TRAINING**9**

Safety Education & Training-Importance, Various training methods, Effectiveness of training, Behaviour oriented training. Communication- purpose, barrier to communication. House keeping: Responsibility of management and employees. Advantages of good housekeeping . 5s of house keeping. Work permit system-objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT IV SAFETY PERFORMANCE MONITORING**9**

Personal protection in the work environment, Types of PPEs, Personal protective equipment-respiratory and non respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Cost of accidents – Computation of Costs-Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Safety surveys, and Safety audits. Safety Inventory Technique.

UNIT V ACCIDENT INVESTIGATION AND REPORTING**9**

Accident investigation- Why? When? Where? Who? and How? Basics- Man- Environment and Systems. Process of Investigation -Tools-Data Collection- Handling witnesses- Case study. Accident analysis- MORT-Multi Events Sequencing-TOR.

TOTAL : 45 PERIODS**OUTCOMES**

Students able to know

CO 1 To understand the functions and activities of safety engineering department.

CO 2 To carry out a safety audit and prepare a report for the audit.

CO 3 To prepare an accident investigation report.

CO 4 To estimate the accident cost using supervisors report and data.

CO 5 To identify various agencies, support in situations and government organizations involved in safety training and promotion

TEXTBOOKS

1. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, , 1969 4th Edition
2. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.

REFERENCES:

1. Krishnan, N.V. (1997). Safety management in Industry .Jaico Publishing House, New Delhi.
2. John V. Grimaldi and Rollin H. Simonds. (1989) Safety management, All India Traveller Book Seller, Delhi.
3. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi.
4. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
5. Akhil Kumar Das, "Principles of Fire Safety Management " Eastern Economy Edition, 2020

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	-	2	-	3	-	2	-	3	2	2	3	-
2	1	-	3	-	1	2	3	-	1	2	3	1	-	3	-
3	-	2	3	-	-	2	3	-	-	2	3	-	2	3	-
4	2	-	3	2	-	1	3	2	-	1	3	2	-	3	2
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVg.	1.66	2	3	2	1.5	1.66	3	2	1.5	1.66	3	1.66	2	3	2

COURSE OBJECTIVES:

1. Understand the basic principles of operation of rotating electric machines (Generators and Motors), their classification and basic efficiency and performance characteristics.
2. Brief the legislative requirements for electrical safety- national/international laws/codes of practices/ standards and/or regulations.
3. Use a "Status Check" survey to assess the facility's electrical safety program and where necessary develop strategies for improvement.
4. Identify persons who may be exposed to a source of electrical energy directly or indirectly.
5. Describe the essential parts of a Flash Hazard Analysis and list the data required analysis.

UNIT I ELEMENTARY IDEAS OF DC MACHINES, TRANSFORMERS AND RELAYS

Construction and Principle of operation of D.C machines - e.m.f equation of a generator - losses and efficiency. Construction and Principle of operation of single phase transformers - e.m.f equation - phase diagrams - equivalent circuit - regulation - losses and efficiency. Protective relays - Requirement of relay - types of protection – classification - distance relay, differential relay, state relays.

UNIT II SYNCHRONOUS, INDUCTION MOTOR, AND THEIR ELECTRICAL CIRCUIT BREAKERS

9

Synchronous machines - types - e.m.f equation - winding factors - armature reaction and leakage resistance. applications. Induction Motors – Construction and principle of operation - equivalent circuit - Torque - slip characteristics - method of starting - applications. Circuit breakers - function of switch gear - arc phenomenon - initialization of an arc – arc interruption - recovery voltage and restriking voltage - MCB and ELCB. Faults in power systems - causes - types.

UNIT III ELECTRICAL GROUNDING, EARTHLING AND INSULATION

9

Fuses - types - selection - advantages and disadvantages. Grounding - neutral grounding – solid grounding - resistance grounding - arc suppression coil grounding. Equipment grounding for safety - grounding substation - grounding of line structure. Earthing Effect of electric and magnetic fields - Human safety aspects - effect of current and voltage on human beings - typical V-I characteristics of skin - Electric shocks and their prevention. Insulation - classes of insulation - FRLS insulation - continuity test.

UNIT IV SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE

9

Safety during installation of plant and equipment. Safe sequences in installation - risk during installation. Safety during testing and commissioning. Test on relays - protection and interlock systems for safety. Hazardous zones - classification of hazardous zones. Intrinsically safe and explosion proof electrical apparatus. Selection of equipments in hazardous area. Electrical fires - hazards of static electricity. Safe procedures for electrical maintenance - Statutory requirements. Safety provisions in Indian Electricity Act & Rules.

UNIT V ELECTRICITY AND FIRE SAFETY

9

power factor improvement – equipments – Importance of P.F. improvement – Disadvantages of low power factor – Causes of low P.F. – Personal Protective equipments (PPE's) used in connection with safe use of electricity like Hand Gloves, Rubber Shoes, Waist belt, , earthing rod, Goggles etc., Safe working clearances for different voltage levels, fire extinguishers used for different applications, knowledge of Static electricity, Lightning protection, Electrical Safety Audit, elementary knowledge of first aid.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Students able to

- CO 1 Explain Indian electricity rules and acts and their significance
- CO 2 Understand the need of electrical safety in different locations
- CO 3 Understand the need of electrical safety during installation of equipment's
- CO 4 Explain the necessity of electrical safety in Hazardous zones
- CO 5 Understand electrical safety in distributed systems

TEXT BOOKS:

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. PradeepChaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997.

REFERENCES:

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004
3. J. Maxwell Adams. Electrical Safety A guide to the causes and prevention of electrical hazards, Published by The Institution of Engineering and Technology, London, United Kingdom, First published 1994 Reprinted 1997, 2004, 2009
4. Fordham-Cooper, W. (1998). Electrical safety engineering. Elsevier by Amsterdam. Bill Atkinson & Roger Lovegrove & Gary Gundry(auth.) Electrical Installation Designs, Fourth Edition @ 2013, John Wiley & Sons, Ltd
5. Kothari, D.P. and Nagrath, I.J. (2009). Basic electrical engineering. (Third edition). Tata McGraw Hill Publishing Company Ltd., New Delhi.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		2	-	-	1	1	-	-	-	-	-	1	-	1
2	-		-	-	-	3	-	-	2	1	-	-	2	2	-
3	2		-	-	-	1	-	1	-	-	-	-	-	-	3
4	2		2	-	-	1	-	-	1	-	-	-	1	1	-
5	2		2	-	-	-	1	-	-	-	-	1	-	-	1
AVg.	2.25	-	2		-	1.5	1	1	1.5	1	-	1	1.33	1.5	1.66

PROGRESS THROUGH KNOWLEDGE

SF3303

PRINCIPLES OF CHEMICAL ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

Understand the overall view of the chemical engineering subjects

UNIT I

9

Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society ;Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II

9

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control.

UNIT III**9**

Concept of Unit Processes and Unit Operations; Description of different Unit Processes and Unit Operations; Designing of equipments; Flow sheet representation of process plants, Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Demonstration of simple chemical engineering experiments; Plantvisittoa chemical industry

UNIT IV**9**

Role of Computer in Chemical Engineering; Chemical Engineering Software; Visit to Process Simulation Lab; Relation between Chemical Engineering and the reengineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering: Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Plantvisittoan allied industry.

UNIT V**9**

Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers ; Future of Chemical Engineering.

OUTCOMES

- CO 1 On completion of the course, students will attain knowledge in fluid behavior and solid properties,
 CO 2 Understand the concept of chemical engineering principles

TEXT BOOKS

1. SalilK. Ghosal, Siddhartha Datta "Introduction to Chemical Engineering" Tata McGraw-Hill Education
2. BadgerW.L. and BancheroJ.T., "Introduction to Chemical Engineering", 6th Edition, Tata McGraw Hill,1997.
3. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by GopalaRao,M. and M.Sittig,2nd Edition, Affiliated East-Westpress,1993.
4. Randolph Norris Shreve, GeorgeT. Austin ,“Shreve’e Chemical Process Industries”, 5th edition ,McGrawHill,1984

REFERENCES

1. Finlayson, B.A., Introduction to Chemical Engineering Computing, John Wiley & Sons, NewJersey,2006.
2. McCabe,W.L.,Smith,J.C.andHarriot,P.“Unit operations in Chemical Engineering”,McGrawHill, 7th Edition.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	3		2	2	3	-	2	-	3	-	2	-	3
2	1	2	3		1	-	3	-	1	2	3	-	1	2	3
3	-	2	3		-	2	3	-	-	2	3	-	-	2	3
4	-	1	3		2	-	3	2	-	1	3	2	-	1	3
5	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Avg.	1.5	1.6 6	3	-	1.66	2	3	2	1.5	1.66	3	2	1.5	1.66	3

COURSE OBJECTIVES:

1. Understand the laws governing electric circuits
2. Study the load and speed characteristics of D.C motors
3. Do load test on single phase transformer

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's Laws
2. Verification of Superposition Theorem
3. Study of B.H. Curve on C.R.O
4. Measurement of power in an A.C. circuit by 3 ammeters and 3 voltmeter method
5. Load test on a DC series motor
6. Speed characteristics of DC shunt motor
7. Regulation of a Transformer
8. Load characteristics of a 3 phase induction motor
9. Study of protective relays and circuit breakers.
10. Study of insulation testing and ground testing.

TOTAL: 60 PERIODS**OUTCOMES:**

On completion of this course the student will be able to:

CO1: Understand the laws governing electric circuits

CO2: Study the load and speed characteristics of D.C motors

CO3: Do load test on single phase transformer

CO4: Study the load and speed characteristics of A.C motors

CO5: Understand the functions of protective relays and circuit breakers.

CO6: Impart knowledge on electric circuits, DC motors, single phase transformers, AC motors, Protective relays and circuit breakers.

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	-	3	3	3	-	2	-	2	3	-	1
2	3	-	3	-	-	2	1	-	-	-	-	-	3	-	1
3	3	-	-	-	2	3	3	3	-	-	-	-	3	-	1
AVg.	3	3	2.5	-	3	2.6	2.5	3	-	2	-	2	3	-	1

OBJECTIVES

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To provide necessary basics in probability and random processes that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

UNIT I PROBABILITY AND RANDOM VARIABLES 9 + 3

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT II TWO- DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III VECTOR SPACES 9 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT IV LINEAR TRANSFORMATION AND DIAGONALIZATION 9 + 3

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors –Diagonalization.

UNIT V INNER PRODUCT SPACES 9 + 3

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

TOTAL : 60 PERIODS**OUTCOMES:**

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

- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non-trivial problems related to the concepts and by proving simple theorems about the statements proven by the text.
- Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

TEXT BOOKS

1. Johnson. R.A., Miller. I and Freund. J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
3. Spiegel. M.R., Schiller. J. and Srinivasan . R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
4. Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
5. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
6. Strang. G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.

SF3401

OCCUPATIONAL HEALTH AND HYGIENE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Anticipate, recognize, evaluate and control hazardous conditions and practices affecting people, property and the environment.
2. Communicate and interact effectively with technical and non-technical audiences.
3. Integrate ethical, social, current, and global issues and responsibilities in their practice as a professional in the field.
4. Work individually or on a team to critically analyze, interpret, and provide leadership to address and manage problems in occupational safety and health.
5. Recognize that the practice of occupational safety and health requires ongoing learning, and undertake appropriate activities to address this need.

UNIT I OCCUPATIONAL HAZARD AND CONTROL PRINCIPLES

9

Concept and spectrum of health- functional units and activities of occupational health services occupational and work related disease- Levels of prevention of diseases - notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, and anthrax - Lead-Nickel, chromium and manganese toxicity- gas poisoning (such as CO, ammonia, coal and dust), their effects and prevention - Industrial toxicology - local and systemic and chronic effects, temporary and cumulative effects - threshold limit values, calculation of TLVs - carcinogens, mutagens, teratogens. Instruments for Radiation detection and measurement. Early recognition of radiation hazard. Personal monitoring devices, Medical support. Hazards associated with the following radiations and preventive measures- Laser, infra-red, ultra violet and ELF.

UNIT II PHYSICAL HAZARD MEASUREMENT, EVALUATION AND CONTROL

9

Recognition, evaluation and control of physical hazards. Vibration - description and measurement of vibration. Vibration control methods. Effects of whole body vibration on human body and control measures. Noise- noise measurement, evaluation, noise control methods -hearing loss - causes - Biological effects of noise exposure. Thermal stress - heat disorders and health effects such as heat exhaustion, heat cramp etc. WBGT index, acclimatization. Ventilation systems - purpose of ventilation-general principles ventilation requirements. Physiological and comfort level. Natural ventilation - Dilution ventilation - Mechanical ventilation - Local exhaust ventilation - Ventilation measuring instruments. Fundamentals of hood and duct designs. Standards on ventilation. Purpose of lighting. Advantages of good illumination. Lighting and the work. Sources and kinds of artificial lighting principles of good illumination. Design of lighting installation. Maintenance. Lighting and colour. Standards on lighting and illuminations.

UNIT III PRINCIPLES OF FIRST AID

9

First Aid principles-Role of the first aider-sequence of action on arrival at scene. Vital signs-breathing -pulse. Introduction to the body-basic anatomical terms-body cavities-head- cranium - thorax- abdomen and pelvis. Biomechanics - Structure and functions of musculoskeletal systems, tendons, ligaments, fascia, bone, muscles, joints and basic mechanisms. Fainting-recognition management-aftercare. Diabetes – hypoglycaemia – hyper glycaemia- management. Seizures (epileptic fits, convulsions) features- management, stroke. Head injuries-fractures of the base vault and sides of skull.

UNIT IV FIRST-AID PRACTICE IN INDUSTRY

9

The circulatory system-heat attack-chest compression- CPR. Shock -causes - signs and symptoms - management of shock. Eye-eye injuries-foreign body in eye-eye trauma-corrosive chemical in eye-eye.Wounds -bleeding-classification-types of wounds-case of wounds- bleeding from special sites. Fractures- classification of fractures-principles of immobilisation- sprains and dislocation. Broad and narrow fold bandages-hand bandages-slings. The skin Poisoning. Physical fitness. Lifting -casualty handling. Use of stretchers.

UNIT V OCCUPATIONAL AND PSYCHOLOGICAL HAZARDS

9

Elements of Industrial Psychology-Mental Health in Industries- Organisational Behaviour, Motivational Theory, Job Satisfaction Value system, Habits, Drug Abuse-Alcoholism in Industry, Communications, Psychological Hazards - Workplace Stress- General Adaptation Syndrome Eustress –Distress Diseases/Disorders related to Work stress- Psychosomatic disorders. Managing Work-stress in industry- Individual responsibilities - Employers Responsibilities. Psychological Counseling of employees- Employees Assistance Programme, Behaviour based Safety.

TOTAL: 45 PERIODS

OUTCOMES:

Students able to

- CO 1** An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to occupational safety and health.
- CO 2** An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
- CO 3** An ability to communicate effectively with a range of audiences.
- CO 4** An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.
- CO 5** An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

TEXT BOOKS:

1. Goetsch D.L., (1999), Occupational Safety and Health for Technologists, Engineers and Managers, Prentice Hall.
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York

REFERENCES:

1. Fundamentals of Industrial Hygiene. 5th Ed. Plog, Barbara and Patricia Quinlain. Chicago, IL: National Safety Council, 2001
2. The industrial environment - its evaluation and control. DHHS (NIOSH) publication number 74-117, 1973.
3. Clayton, C.D. and Clayton, F. (1981). Patty's industrial hygiene and toxicology. Wiley Interscience, New York.
4. The Occupational Environment Its Evaluation and Control. 2nd Ed. Dinardi, Salvatore. Fairfax, VA: American Industrial Hygiene Association, 2003.
5. Australian and New Zealand master work health and safety guide by Cormack E. Dunn ISBN: 9781925397130 Publication Date: 3rd ed. 2018 Print only. Copies in High Use Collection JOO & BUN.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	3	-	-	-	1	-	-	1	-	-	-	-	2	-
2	-	1	-	2	-	-	-	3	-	-	2	-	-	-	1
3	1		1	-	-	-	-	-	-	3	-	-	3	-	-
4	-		-	-	-	1	-	-	-	1	1	-	-	1	-
5	1		1	-	-	-	-	-	-	-	-	-	-	-	-
AVg.	1	2	1	2	-	1	-	3	1	2	1.5	-	3	1.5	1

CE3491

STRENGTH OF MATERIALS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION

9

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

UNIT IV DEFLECTION OF BEAMS

9

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

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS

9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lamé's theory.

TOTAL: 45 PERIODS

OUTCOMES:**At the end of the course the students would be able to**

1. Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
2. Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
3. Apply basic equation of torsion in designing of shafts and helical springs
4. Calculate slope and deflection in beams using different methods.
5. Analyze thin and thick shells for applied pressures.

TEXT BOOKS:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018.
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.

REFERENCES:

1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019.
4. Vazirani. V.N, Ratwani. M.M, Duggal .S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
2	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
3	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
4	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
5	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
Low (1) ; Medium (2) ; High (3)															

COURSE OBJECTIVES:

1. Anticipate, identify and evaluate hazardous conditions and practices.
2. Develop hazard control designs, methods, procedures, and programs.
3. Illustrate the basic concepts and techniques of modern reliability engineering tools.
4. To provide the students an illustration of significance of the Fire Engineering profession in the protection life, property and environment.
5. To understand the importance of life safety in building fire and method of evacuation.

UNIT I PROPERTIES OF COMBUSTION 9

Introduction- temperature, heat, specific heat, flash point, fire point, ignition, combustion; Ignition- pilot ignition, spontaneous ignition, Types of combustion-rapid, spontaneous, explosion;. Development of fire- incipient, smoldering, flame and heat stages; Diffusion flames-zones of combustion, smoldering combustion,; Premixed flames-burning velocity, limits of flammability, explosion and expansion ratios, deflagration and detonation, characteristics of premixed flame; Explosion- physical explosion, chemical explosion; Special kinds of combustion- Flash fire, Pool fire, Deep seated fire, Spillover, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material.

UNIT II BEHAVIOUR OF BUILDING ELEMENTS UNDER ACTION OF FIRE 9

Product of combustion-flame, heat, smoke, fire gases; spread of fire in rooms and buildings; Effect of heat exposure to human body Smoke - constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke, smoke movement in buildings, modeling of smoke movement; Smoke control in buildings natural and mechanical ventilation, pressurization; Design principles of smoke control using pressurization technique; Principles of smoke vent design. Toxicity of smoke- effect of harmful agents preventing escape and causing injury or death - CO, CO₂, HCN, SO₂, NH₃, Nitrogen oxide.

UNIT III OPERATION HANDLING AND MAINTENANCE OF FIRE SERVICE EQUIPMENTS AND ACCESSORIES 9

Introduction to fire fighting vehicles and appliances- Pumps, primers, crash tenders, rescue tenders, hose laying tenders, control vans, hydraulic platforms - Delivery Hose, Hose reel, Hose fittings- coupling, adapters, branches, branch holders, radial branches, collecting heads, stand pipe, monitors, hydrants;; Ladders- Uses and maintenance of small gear and miscellaneous equipments used during fire fighting; Lamps and lighting sets; Ropes and Lines- Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches; General rope work.

UNIT IV HYDRAULIC SYSTEM THROUGH KNOWLEDGE 9

Fire stream-path, range; nozzles-types, calculation of discharge capacity, nozzle reaction; friction losses in pipes, fire hoses and fixtures, parallel and series connections; Flow in pipes and fire hoses, branching lines; water relay techniques; Estimation of fire protection water requirements, pump capacity and other parameters relating to fire hydraulics. Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations.

UNIT V FIRE SUPPRESSION & PROTECTION 9

Introduction, Definitions, Water as an extinguishing agent, Basic Components of a Fire Protection system, Classification of fire protection systems-Active & Passive: Active FPS Definitions, classifications- Water Based (Vs) Non water based & Fixed (Vs) Portable/Mobile, Types:- Fire Extinguishers, Fire hydrants, Sprinklers, standpipe systems, Fire detectors, water spray systems - definitions, types, operation, applications & limitations, selection, installation & maintenance as per relevant national and international standards(IS, OISD, NFPA etc)

TOTAL: 45 PERIODS

COURSE OUTCOMES:**Students able to**

- CO 1** Explain the basics of fire engineering.
- CO 2** Classify the types of combustion and its products.
- CO 3** Demonstrate the operation of fire service equipment's and practical fire fighting.
- CO 4** Categorize the buildings and design the evacuation methods
- CO 5** Apply acquired knowledge on real life problems

TEXT BOOKS:

1. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.
2. Barendra Mohan Sen, "Fire protection and prevention the essential handbook". UBS Publishers' Distributors Pvt. Ltd, 2009.

REFERENCES:

1. Ron Hirst, "Underdowns Practical Fire Precautions", Gower Publishing Company Ltd., England, 1989.
2. Jain V.K. "Fire safety in buildings" (2nd edn.). New Age International (P) Ltd., New Delhi.2010.
3. Barendra Mohan Sen,"Fire protection and prevention the essential handbook", UBS publishers and Dist., New Delhi,2013.
4. "Jain V.K., "Fire Safety in Buildings", New Age International (P) Ltd., New Delhi, 1996
5. N F P A. Fire Protection Hand Book.20th Edition, 2008
6. Michael F. Dennet, "Fire Investigation-A Practical Guide for Students and Officers, Insurance Investigators, Loss Adjusters and Police Officers", Pergamon Press, Year: 1980

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	1	-	-	1	1	-	-	-	-	-	1	-	-
2	-	1	-	-	1	2	-	-	-	1	-	-	3	-	-
3	2	-	-	-	-	1	-	1	1	-	-	-	-	-	3
4	2	1	2	-	1	1	-	-	-	-	-	-	-	1	-
5	1	-	2	-	-	-	-	-	-	-	-	1	-	-	-
Avg.	1.75	1	1.66		1	1.25	1	1	1	1	-	1	2	1	3

SF3403

PROGRESS SAFETY IN CONSTRUCTION EDGE

L T P C
3 0 0 3**OBJECTIVES:**

1. know causes of accidents related to construction activities and human factors associated with these accident
2. Understand the construction regulations and quality assurance in construction
3. Have the knowledge in hazards of construction and their prevention methods
4. know the working principles of various construction machinery
5. gain knowledge in health hazards and safety in demolition work Course

UNIT I INTRODUCTION**9**

Introduction to construction industry and safety issues in construction-Human factors in construction safety management- Roles of various groups and stake-holders in ensuring safety in construction industry -Framing of contract conditions on safety and related matters –Relevance of ergonomics in construction safety.

UNIT II SAFETY IN CONSTRUCTION OPERATIONS

9

Safety in various construction operations - Excavation and filling - Under- water works - Underpinning & Shoring - Ladders & Scaffolds - Tunnelling - Blasting - Dismantling - Confined space-Temporary Structures. noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.Effects of air pollution in Industry, air pollution episodes ;Emission factors inventory and predictive equations. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

UNIT III CONSTRUCTION MACHINERY

9

Safety in material handling and equipment's-Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles - excavators, graders and dozers - cranes - hoists & lifts - other lifting gears~ wire ropes - chain-pulley blocks - mixers -conveyors- pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

UNIT IV CONSTRUCTION ACT AND CODE OF PRACTICES

9

Contract Labour (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building& Other Construction Work (RE & CS) Act, 1996 and Central Rules, 1998: Applicability,Administration,Registration,WelfareBoard&WelfareFund,Training of Building workers, General Safety, Health & Welfare provisions. Code of Practices - -Preventive measures against Hazards at work places Part1&2

UNIT V SAFETY IN DEMOLITION WORK

9

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision ,safe clearance zone, health hazardsfrom demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods–Case studies in construction sites against the fire accidents.

TOTAL:45 PERIODS

OUTCOMES

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

- CO 1 Visualize the safety issues at different stages of construction activity.
- CO 2 Understand the safety requirements in various construction operation sand develop guidelines to ensure safety at construction site.
- CO 3 Understand the safety requirements in material handling and Equipments and develop guidelines to ensure safety at construction site.
- CO 4 Learn the legal provisions with respect to the health and welfare of workers at construction site.
- CO 5 List out construction regulations and Indian standards for construction and demolition work

TEXTBOOKS

1. Hudson,R.,”ConstructionhazardandSafetyHandbook,ButterWorth’s,1985.
2. Raymond Elliot Levitt, Nancy Morse Samelson,“ConstructionSafetyManagement,McGraw-Hill,London,1987.

REFERENCES:

1. Jnathea D.Sime,“Safety in the Build Environment”,London,1988.
2. Davies,V. J., and Tomasin,K.(1996).Construction safety hand book.Thomas Telford Publishing ,London.
3. Ratay,R.T.(1996).Handbook of temporary structures in construction(2ndedn.).McGraw-Hill,London.
4. Fulman,J.B.,ConstructionSafety,Security& Loss Prevention,John WileyandSons,1979
5. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act,1996 and Central Rules.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	3	2	2	3	-	3		2		1	-	2	2
2	1	2	3	1	-	3	-	-	1	3	1	1	-	1	3
3	-	2	3	-	2	3	-	1		-		-	1	-	-
4	-	1	3	2	-	3	2	-	1	1		2	2	-	1
5	-	-	-	-	-	-	-	-		-		-	-	-	-
AVg.	1.5	1.66	3	1.66	2	3	2	2	1	2.5	1	1.33	1.5	1.5	2.5

GE3451

ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

L T P C
2 0 0 2**UNIT I ENVIRONMENT AND BIODIVERSITY**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHSMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY .

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT

Development, GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

SF3411

INDUSTRIAL HYGIENE LABORATORY

**L T P C
0 0 4 2**

COURSE OBJECTIVES

1. Evaluate the different pollutants in the atmosphere using air sampling Equipment
2. Evaluate heat stress in industries.
3. Measure different physical hazards such as noise, illumination etc.

LIST OF EXPERIMENTS:

1. Study of Personal Protective equipment
2. Study of occupational diseases with photographic models.
3. Demonstration of Air sampling equipment.
4. Sampling and estimation of dusts using high volume sampler
5. Sampling and estimation of dust using personal sampler
6. Measurement of Noise
7. Measurement of illumination
8. Vision testing
9. Lung functions testing.
10. Measurement of thermal stress.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course the student will be able to

CO1: The students will be able to Study of Personal Protective equipment

CO2: The students will be able to Study of occupational diseases with photographic

CO3: The students will be able to Measurement of Noise.

CO4: The students will be able to Measurement of illumination

CO5: The students will be able to Measurement of thermal stress.

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	-	-	-	3	3	-	3	-	3	-	1
2	-	-	3	-	2	-	2	1	-	-	3	-	3	-	1
3	2	-	-	-	3	-	-	-	3	-	3	-	3	-	1
AVg.	2.5	3	2.5	-	2.5	-	2	2	3	-	3	-	3	-	1

CE348 STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVE:

1. To study the mechanical properties of metals, wood and spring by testing in laboratory.
2. To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory.

UNIT – I STRENGTH OF MATERIALS **30**

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

UNIT – II FLUID MECHANICS AND MACHINES LABORATORY **30**

LIST OF EXPERIMENTS

1. (a) Determination of coefficient of discharge of a venturimeter
(b) Determination of friction factor for flow through pipes
2. (a) Determination of metacentric height
(b) Determination of forces due to impact of jet on a fixed plate
3. Characteristics of centrifugal pumps
4. Characteristics of reciprocating pump
5. Characteristics of Pelton wheel turbine

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Determine the tensile, torsion and hardness properties of metals by testing
2. Determine the stiffness properties of helical and carriage spring
3. Apply the conservation laws to determine the coefficient of discharge of a venturimeter and finding the friction factor of given pipe
4. Apply the fluid static and momentum principles to determine the metacentric height and forces due to impact of jet
5. Determine the performance characteristics of turbine, rotodynamic pump and positive displacement pump.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	3	3	1	1	1	3	1	1	2	2	2	1
2	3	2	1	3	3	1	1	1	3	1	1	2	3	2	1
3	3	3	2	3	2	1	1	1	3	1	1	2	3	2	1
Low (1) ; Medium (2) ; High (3)															

