



THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

Mecheri, Salem - 636 453.



Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF CHEMICAL ENGINEERING



**AUTONOMOUS
CURRICULUM AND**

**UG
REGULATIONS**

2024

Academic Year 2024-25 onwards

SYLLABUS

I-VIII

SEMESTERS



The Kavery Engineering College



Mecheri, Mettur Tk. Salem Dt – 636 453.

(An Autonomous Institution Approved by AICTE, New Delhi & Affiliated to Anna University)

An ISO 9001:2015 certified Institution and accredited by NAAC with A+ grade.

B.Tech. CHEMICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR SEMESTER I TO VIII

(Applicable to the students admitted from the Academic year 2024-2025 onwards)

VISION

- To be a centre of excellence for development and dissemination of knowledge in Chemical Engineering for the nation.

MISSION

- To impart knowledge to students at all levels through a vibrant, dynamic and state of art intellectual delivery to ensure the creation of a complete Chemical Engineer with a high sense of social responsibility and professional ethics.
- Synergize the efforts of the students and faculty to evolve innovative Engineering practices and teaching methodologies.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- ❖ To inculcate conceptual knowledge in the field of Chemical engineering.
- ❖ To impart problem solving, analytical skills in the contemporary processes.
- ❖ To expedite state of art laboratory facility to offer practical Knowledge.
- ❖ To design and develop eco-friendly sustainable technologies with the aid of computational skills.
- ❖ To facilitate the ability to learn, innovate and communicate technical developments for the benefit of humanity.

PROGRAMME OUTCOMES (POS)

After going through the four years of study, our graduates will exhibit ability to:

PO	Graduate attribute	Programme outcome
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 analyse 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.	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
8.	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
9.	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.
10.	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.
11.	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)

- ❖ Graduates will have a strong foundation in engineering, science and current Chemical Engineering practices and will have experience in solving structured and unstructured problems using conventional and innovative solutions.
- ❖ Graduates will be able to effectively describe the Chemical Engineering problem, analyze the data, develop potential solutions, evaluate these solutions, and present the results using their oral, written and electronic media skills.
- ❖ Graduates will have an understanding of ethical and professional responsibilities of an engineer and the impact of engineering solutions on society and the global environment.

THE KAVERY ENGINEERING COLLEGE, MECHERI (AUTONOMOUS)
REGULATIONS - 2024
CHOICE BASED CREDIT SYSTEM
B.TECH. CHEMICAL ENGINEERING
CURRICULUM & SYLLABI FOR I TO VIII SEMESTERS
(For the students admitted 2024 onwards)

SEMESTER – I										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UENT24101	Professional English –I	3	0	0	3	40	60	100	HSMC
2.	UMAT24102	Matrices and Calculus	3	1	0	4	40	60	100	BSC
3.	UPHT24103	Engineering Physics	3	0	0	3	40	60	100	BSC
4.	UCHT24104	Engineering Chemistry	3	0	0	3	40	60	100	BSC
5.	UPST24105	Problem Solving and Python Programming	3	0	0	3	40	60	100	ESC
6.	UTAT24106	Heritage of Tamils / தமிழர் மரபு	1	0	0	1	40	60	100	HSMC
Laboratory Courses										
7.	UPSL2413	Problem Solving and Python Programming Laboratory	0	0	4	2	60	40	100	ESC
8.	UPCL2412	Physics and Chemistry Laboratory	0	0	4	2	60	40	100	BSC
Employability Enhancement Courses										
9.	UENL2411	English Laboratory \$	0	0	2	1	60	40	100	EEC
Mandatory Courses										
10.	UIPE24101	Induction Programme	-	-	-	-	-	-	-	MC
	Total Credits to be earned					22				

\$ - Skill Based Course

SEMESTER – II										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UENT24201	Professional English – II	2	0	0	2	40	60	100	HSMC
2.	UMAT24201	Statistics and Numerical Methods	3	1	0	4	40	60	100	BSC
3.	UPHT24207	Physics of Materials	3	0	0	3	40	60	100	BSC
4.	UGET24201	Engineering Graphics	2	0	0	4	40	60	100	ESC
5.	UBET24201	Basic Electrical, Electronics and Instrumentation Engineering	3	0	0	3	40	60	100	ESC
6.	UCHT24201	Introduction to Chemical Engineering	3	0	0	3	40	60	100	PCC
7.	UTAT24201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1	0	0	1	40	60	100	HSMC
Laboratory Courses										
8.	UGEL24201	Engineering Practices Laboratory	0	0	4	2	60	40	100	ESC

9.	UBEL24201	Basic Electrical, Electronics and Instrumentation Engineering	0	0	4	2	60	40	100	ESC
Employability Enhancement Courses										
10.	UGEL24202	Communication Laboratory/ /Foreign Language \$	0	0	4	2	60	40	100	EEC
Mandatory Courses										
11.	UNCC24001	NSS/YRC/SPORTS /CLUBS	-	-	2	0	-	-	-	MC
	Total Credits to be earned					26				
\$ -Skill Based Course										

SEMESTER – III

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UMAT24303	Differential Equations	3	1	0	4	40	60	100	BSC
2.	UCHT24301	Basic Mechanical Engineering	3	0	0	3	40	60	100	ESC
3.	UCHT24302	Mechanics of Solids	3	0	0	3	40	60	100	ESC
4.	UCHT24303	Chemical Process Calculations	3	0	0	3	40	60	100	PCC
5.	UCHT24304	Fluid Mechanics for Chemical Engineers	3	0	0	3	40	60	100	PCC
6.	UCHT24305	Chemical Process Industries	3	0	0	3	40	60	100	PCC
Laboratory Courses										
7.	UCHL24301	Basic Mechanical Engineering Laboratory	0	0	3	1.5	60	40	100	ESC
8.	UCHL24302	Technical Analysis Laboratory	0	0	3	1.5	60	40	100	PCC
9.	USD24301	Soft Skill 1	2	0	0	0	100	-	100	MC
	Total Credits to be earned					22				

SEMESTER – IV

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UMAT24401	Transform Techniques	3	1	0	4	40	60	100	BSC
2.	UCHT24401	Mass Transfer I	3	0	0	3	40	60	100	PCC
3.	UCHT24402	Mechanical Operations	3	0	0	3	40	60	100	PCC
4.	UCHT24403	Chemical Engineering Thermodynamics – I	3	0	0	3	40	60	100	PCC
5.	UCHT24404	Heat Transfer	3	0	0	3	40	60	100	PCC
6.	UESST24401	Environmental Sciences and Sustainability	2	0	0	2	40	60	100	BSC

Laboratory Courses										
7.	UCLH24401	Fluid Mechanics Laboratory	0	0	3	1.5	60	40	100	PCC
8.	UCLH24402	Mechanical Operations Laboratory	0	0	3	1.5	60	40	100	PCC
9.	USD24401	Soft Skill 2	2	0	0	0	100	-	100	MC
Total Credits to be earned						21				

SEMESTER – V										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UCHT24501	Chemical Engineering Thermodynamics – II	3	0	0	3	40	60	100	PCC
2.	UCHT24502	Mass Transfer – II	3	0	0	3	40	60	100	PCC
3.		Professional Elective – I	3	0	0	3	40	60	100	PEC
4.		Professional Elective – II	3	0	0	3	40	60	100	PEC
5.		Professional Elective – III	3	0	0	3	40	60	100	PEC
Laboratory Courses										
6.	UCHL24501	Computational Chemical Engineering Laboratory	0	0	3	1.5	60	40	100	PCC
7.	UCHL24502	Heat Transfer Laboratory	0	0	3	1.5	60	40	100	PCC
Employability Enhancement Courses										
8.	USI24501	Summer Inernship *	0	0	0	1	100	-	100	EEC
9.	UIDL24001	IDEA Lab	0	0	1	1	100	-	100	EEC
Mandatory Courses										
10.		Mandatory Course- I	2	0	0	0	100	-	100	MC
11.	USD24501	Soft Skill 3	2	0	0	0	100	-	100	MC
	Total Credits to be earned					20				

*Two weeks Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester.

SEMESTER – VI										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UCHT24601	Chemical Reaction Engineering – I	3	0	0	3	40	60	100	PCC
2.	UCHT24602	Process Dynamics and Control	3	0	0	3	40	60	100	PCC
3.		Professional Elective – IV	3	0	0	3	40	60	100	PEC
4.		Professional Elective – V	3	0	0	3	40	60	100	PEC
5.		Open Elective – I	3	0	0	3	40	60	100	OEC

Laboratory Courses										
6.	UCHL24601	Process Control Laboratory	0	0	3	1.5	60	40	100	PCC
7.	UCHL24602	Mass Transfer Laboratory	0	0	3	1.5	60	40	100	PCC
Employability Enhancement Courses										
8.	UMP24601	Mini Project	0	0	4	2	50	50	100	EEC
Mandatory Courses										
9.		Mandatory Course –II	3	0	0	0	100	-	100	MC
10.	USD24601	Soft Skill 4	2	0	0	0	-	-	-	MC
Total Credits to be earned						20				

SEMESTER – VII										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.	UCHT24701	Chemical Reaction Engineering II	3	0	0	3	40	60	100	PCC
2.	UCHT24702	Transport Phenomena	3	0	0	3	40	60	100	PCC
3.	UGET24707	Human values and Ethics	2	0	0	2	40	60	100	HSMC
4.		Elective – Management	3	0	0	3	40	60	100	HSMC
5.		Open Elective – II	3	0	0	3	40	60	100	OEC
6.		Open Elective – III	3	0	0	3	40	60	100	OEC
Laboratory Courses										
7.	UCHL24701	Chemical Reaction Engineering Laboratory	0	0	3	1.5	60	40	100	PCC
8.	UCHL24702	Process Equipment Design and Drawing	0	0	3	1.5	60	40	100	PCC
Employability Enhancement Courses										
9.	USI24701	Summer Internship #	0	0	0	1	100	-	100	EEC
	Total Credits to be earned					21				

Two weeks Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII Semester.

SEMESTER – VIII										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
Theory Courses										
1.		Professional Elective – VI	3	0	0	3	40	60	100	PEC
2.		Open Elective – IV	3	0	0	3	40	60	100	OEC
Employability Enhancement Courses										
3.	UCHL24801	Project Work/ Internship	---	---	20	10	50	50	100	EEC
	Total Credits to be earned					16				

CREDITS SUMMARY

B.TECH. CHEMICAL ENGINEERING											
S.No.	Subject Area	Credits per Semester								Total Credits	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	3					5		12	7
2	BSC	12	7	4	6					29	17
3	ESC	5	11	7.5						23.5	14
4	PCC		3	10.5	15	9	9	9		55.5	33
5	PEC					9	6		3	18	11
6	OEC						3	6	3	12	7
7	EEC	1	2			2	2	1	10	18	11
8	Non-Credit / (Mandatory)					✓	✓			-	
TOTAL		22	26	22	21	20	20	21	16	168	100

ELECTIVE – MANAGEMENT COURSES

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UGET24701	Principles of Management	3	0	0	3	40	60	100	HSMC
2.	UGET24702	Total Quality Management	3	0	0	3	40	60	100	HSMC
3.	UGET24703	Engineering Economics and Financial Accounting	3	0	0	3	40	60	100	HSMC
4.	UGET24704	Human Resource Management	3	0	0	3	40	60	100	HSMC
5.	UGET24705	Knowledge Management	3	0	0	3	40	60	100	HSMC
6.	UGET24706	Industrial Management	3	0	0	3	40	60	100	HSMC

MANDATORY COURSES I & II

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UMC24001	Disaster Risk Reduction and Management	2	0	0	0	100	-	100	MC
2.	UMC24002	Elements of Literature	2	0	0	0	100	-	100	MC
3.	UMC24003	Film Appreciation	2	0	0	0	100	-	100	MC
4.	UMC24004	Introduction to Gender Studies	2	0	0	0	100	-	100	MC
5.	UMC24005	Industrial Safety	2	0	0	0	100	-	100	MC
6.	UMC24006	Interpersonal Skills	2	0	0	0	100	-	100	MC
7.	UMC24007	Personality and Character Development	2	0	0	0	100	-	100	MC
8.	UMC24008	Well - Being with Traditional Practices Yoga, Ayurveda and Siddha	2	0	0	0	100	-	100	MC

PROFESSIONAL ELECTIVE COURSES

STREAM I: PETROLEUM PROCESS TECHNOLOGY										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2401	Petroleum Chemistry and Refining Fundamentals	3	0	0	3	40	60	100	PEC
2.	UCHPE2402	Primary Refining Technology	3	0	0	3	40	60	100	PEC
3.	UCHPE2403	Secondary Refining Technology	3	0	0	3	40	60	100	PEC
4.	UCHPE2404	Refinery Advancements and Environmental Regulations	3	0	0	3	40	60	100	PEC
5.	UCHPE2405	Petroleum Equipment Design	3	0	0	3	40	60	100	PEC
6.	UCHPE2406	Petrochemical Technology	3	0	0	3	40	60	100	PEC

STREAM II: ENERGY ENGINEERING										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2407	Bioenergy	3	0	0	3	40	60	100	PEC
2.	UCHPE2408	Renewable Energy Resources	3	0	0	3	40	60	100	PEC
3.	UCHPE2409	Pinch Technology	3	0	0	3	40	60	100	PEC
4.	UCHPE2410	Hydrogen And Fuel Cell Technology	3	0	0	3	40	60	100	PEC
5.	UCHPE2411	Power Plant Engineering	3	0	0	3	40	60	100	PEC
6.	UCHPE2412	Non-Renewable Energy Sources	3	0	0	3	40	60	100	PEC

STREAM III: BIOCHEMICAL ENGINEERING										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2413	Biochemistry	3	0	0	3	40	60	100	PEC
2.	UCHPE2414	Bioprocess Technology	3	0	0	3	40	60	100	PEC
3.	UCHPE2415	Fermentation and Bioprocessing	3	0	0	3	40	60	100	PEC
4.	UCHPE2416	Bioseparation and Downstream Processing	3	0	0	3	40	60	100	PEC
5.	UCHPE2417	Enzyme Immobilization Technology	3	0	0	3	40	60	100	PEC
6.	UCHPE2418	Bioreactor Design	3	0	0	3	40	60	100	PEC

STREAM IV: ENVIRONMENTAL AND SAFETY ENGINEERING										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2419	Air Pollution Engineering	3	0	0	3	40	60	100	PEC
2.	UCHPE2420	Waste Water Treatment	3	0	0	3	40	60	100	PEC
3.	UCHPE2421	Solid waste Management	3	0	0	3	40	60	100	PEC
4.	UCHPE2422	Environmental and Social Impact Assessment	3	0	0	3	40	60	100	PEC
5.	UCHPE2423	Process Safety Management	3	0	0	3	40	60	100	PEC
6.	UCHPE2424	Risk and HAZOP Analysis	3	0	0	3	40	60	100	PEC

HONOURS										
COMPUTATIONAL CHEMICAL ENGINEERING										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2425	Computational Techniques	3	0	0	3	40	60	100	PEC
2.	UCHPE2426	Optimization of Chemical Processes	3	0	0	3	40	60	100	PEC
3.	UCHPE2427	Process Modeling and Simulation	3	0	0	3	40	60	100	PEC
4.	UCHPE2428	Pinch Analysis and Heat Exchange Network Design	3	0	0	3	40	60	100	PEC
5.	UCHPE2429	Chemical Process Flow sheeting	3	0	0	3	40	60	100	PEC
6.	UCHPE2430	Computational Fluid Dynamics	3	0	0	3	40	60	100	PEC
CHEMICAL PLANT DESIGN										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHPE2431	Chemical Plant Design	3	0	0	3	40	60	100	PEC
2.	UCHPE2432	Plant Layout	3	0	0	3	40	60	100	PEC
3.	UCHPE2433	Design Safety	3	0	0	3	40	60	100	PEC
4.	UCHPE2434	Material Selection	3	0	0	3	40	60	100	PEC
5.	UCHPE2435	Statutory Requirements and Customer Care	3	0	0	3	40	60	100	PEC
6.	UCHPE2436	Process Plant Utilities	3	0	0	3	40	60	100	PEC

OPEN ELECTIVE COURSES (OEC) Open Elective courses offered by Chemical Engineering to other branches										
S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCHOE2401	Nanomaterials and applications	3	0	0	3	40	60	100	PEC
2.	UCHOE2402	Polymer Technology	3	0	0	3	40	60	100	PEC
3.	UCHOE2403	Enzyme engineering	3	0	0	3	40	60	100	PEC
4.	UCHOE2404	Bio Energy Resources	3	0	0	3	40	60	100	PEC
5.	UCHOE2405	Chemical Process Safety	3	0	0	3	40	60	100	PEC

OPEN ELECTIVE OFFERED BY OTHER DEPARTMENTS

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
COMPUTER SCIENCE AND ENGINEERING										
1.	UCSOE2401	Introduction to C Programming	2	0	2	3	50	50	100	OEC
2.	UCSOE2402	Introduction to Data Structures	2	0	2	3	50	50	100	OEC
3.	UCSOE2403	Data Science Fundamentals	2	0	2	3	50	50	100	OEC
4.	UCSOE2404	Introduction of Data Analytics	2	0	2	3	50	50	100	OEC
5.	UCSOE2405	Artificial Intelligence and Machine Learning Fundamentals	2	0	2	3	50	50	100	OEC
6.	UCSOE2406	IoT Concepts and Applications	2	0	2	3	50	50	100	OEC
ELECTRONICS AND COMMUNICATION ENGINEERING										
7.	UECOE2401	Industrial Electronics	3	0	0	3	40	60	100	OEC
8.	UECOE2402	Image Processing and Computer Vision	3	0	0	3	40	60	100	OEC
9.	UECOE2403	4G/5G Communication Networks	3	0	0	3	40	60	100	OEC
10.	UECOE2404	Wireless Communication	3	0	0	3	40	60	100	OEC
11.	UECOE2405	Embedded and Real Time Systems	3	0	0	3	40	60	100	OEC
12.	UECOE2406	Robotics and its Industrial Application	3	0	0	3	40	60	100	OEC
13.	UECOE2407	Industrial IoT	3	0	0	3	40	60	100	OEC
14.	UECOE2408	Sensors and Transducers	3	0	0	3	40	60	100	OEC
15.	UECOE2409	Space Science	3	0	0	3	40	60	100	OEC
MECHANICAL ENGINEERING										
16.	UMEOE2401	Reverse Engineering	2	0	2	3	50	50	100	OEC
17.	UMEOE2402	Non - Destructive Testing	2	0	2	3	50	50	100	OEC
18.	UMEOE2403	Additive Manufacturing Technology	2	0	2	3	50	50	100	OEC
19.	UMEOE2404	Energy Technology	3	0	0	3	40	60	100	OEC
20.	UMEOE2405	Renewable Energy Technologies	3	0	0	3	40	60	100	OEC
21.	UMEOE2406	Introduction to Industrial Engineering	3	0	0	3	40	60	100	OEC
22.	UMEOE2407	Fiber Reinforced Plastics	3	0	0	3	40	60	100	OEC

23.	UMEOE2408	NANO Technology and its applications	3	0	0	3	40	60	100	OEC
CIVIL ENGINEERING										
24.	UCEOE2401	Architectural Heritage of India	3	0	0	3	40	60	100	OEC
25.	UCEOE2402	Building Planning and Construction	3	0	0	3	40	60	100	OEC
26.	UCEOE2403	Elementary Civil Engineering	3	0	0	3	40	60	100	OEC
27.	UCEOE2404	Energy and Environment	3	0	0	3	40	60	100	OEC
28.	UCEOE2405	Global Warming and Climate Change	3	0	0	3	40	60	100	OEC
29.	UCEOE2406	Introduction to Disaster Management and Mitigation	3	0	0	3	40	60	100	OEC
AGRICULTURAL ENGINEERING										
30.	UAIOE2401	Introduction to Food processing	3	0	0	3	40	60	100	OEC
31.	UAIOE2402	Traditional Indian Foods	3	0	0	3	40	60	100	OEC
32.	UAIOE2403	Fundamentals of Food Engineering	3	0	0	3	40	60	100	OEC
33.	UAIOE2404	Remote Sensing Concepts	3	0	0	3	40	60	100	OEC
34.	UAIOE2405	Basics of Integrated Water Resources Management	3	0	0	3	40	60	100	OEC
BIOMEDICAL ENGINEERING										
35.	UBMOE2401	Basics of Microbial Technology	3	0	0	3	40	60	100	OEC
36.	UBMOE2402	Radiological Equipment	3	0	0	3	40	60	100	OEC
37.	UBMOE2403	Fundamentals of Cell and Molecular Biology	3	0	0	3	40	60	100	OEC
38.	UBMOE2404	Human Physiology	3	0	0	3	40	60	100	OEC
39.	UBMOE2405	Lifestyle Diseases	3	0	0	3	40	60	100	OEC
40.	UBMOE2406	Pathology and Microbiology	3	0	0	3	40	60	100	OEC
41.	UBMOE2407	Medical Electronics	3	0	0	3	40	60	100	OEC
42.	UBMOE2408	Assist Devices	3	0	0	3	40	60	100	OEC
ELECTRICAL AND ELECTRONIC ENGINEERING										
43.	UEEOE2401	Electrical safety	3	0	0	3	40	60	100	OEC
44.	UEEOE2402	Introduction to Electrical Machines	3	0	0	3	40	60	100	OEC
45.	UEEOE2403	Electric Energy Generation, Utilization and Conservation	3	0	0	3	40	60	100	OEC
46.	UEEOE2404	Power Electronics and Drives	3	0	0	3	40	60	100	OEC

47.	UEEOE2405	Electrical Estimation and costing	3	0	0	3	40	60	100	OEC
48.	UEEOE2406	Basics of Electrical Measurements and instrumentation	3	0	0	3	40	60	100	OEC
49.	UEEOE2407	Introduction to control Engineering	3	0	0	3	40	60	100	OEC
50.	UEEOE2408	Fundamentals of Electrical Drives and Control	3	0	0	3	40	60	100	OEC
51.	UEEOE2409	Energy Conservation and Management	3	0	0	3	40	60	100	OEC
52.	UEEOE2410	Automotive Electrical and Electronics Engineering	3	0	0	3	40	60	100	OEC
53.	UEEOE2411	Introduction to Embedded systems	3	0	0	3	40	60	100	OEC

MINOR DEGREE

ENVIRONMENTAL AND SAFETY ENGINEERING

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCMG2401	Financial Management	3	0	0	3	40	60	100	PEC
2.	UCMG2402	Fundamentals of Investment	3	0	0	3	40	60	100	PEC
3.	UCMG2403	Banking, Financial Services and Insurance	3	0	0	3	40	60	100	PEC
4.	UCMG2404	Introduction to Block chain and its Applications	3	0	0	3	40	60	100	PEC
5.	UCMG2405	Fintech Personal Finance and Payments	3	0	0	3	40	60	100	PEC
6.	UCMG2406	Introduction to Fintech	3	0	0	3	40	60	100	PEC

ENTREPRENEURSHIP

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCMG2407	Foundations of Entrepreneurship	3	0	0	3	40	60	100	PEC
2.	UCMG2408	Team Building & Leadership Management for Business	3	0	0	3	40	60	100	PEC
3.	UCMG2409	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100	PEC
4.	UCMG2410	Principles of Marketing Management for Business	3	0	0	3	40	60	100	PEC
5.	UCMG2411	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100	PEC
6.	UCMG2412	Financing New Business Ventures	3	0	0	3	40	60	100	PEC

PUBLIC ADMINISTRATION

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCMG2413	Principles of Public Administration	3	0	0	3	40	60	100	PEC
2.	UCMG2414	Constitution of India	3	0	0	3	40	60	100	PEC
3.	UCMG2415	Public Personnel Administration	3	0	0	3	40	60	100	PEC
4.	UCMG2416	Administrative Theories	3	0	0	3	40	60	100	PEC
5.	UCMG2417	Indian Administrative System	3	0	0	3	40	60	100	PEC
6.	UCMG2418	Public Policy Administration	3	0	0	3	40	60	100	PEC

BUSINESS DATA ANALYTICS

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCMG2419	Statistics For Management	3	0	0	3	40	60	100	PEC
2.	UCMG2420	Data mining For Business Intelligence	3	0	0	3	40	60	100	PEC
3.	UCMG2421	Human Resource Analytics	3	0	0	3	40	60	100	PEC
4.	UCMG2422	Marketing and Social Media Web Analytics	3	0	0	3	40	60	100	PEC
5.	UCMG2423	Operation and Supply Chain Analytics	3	0	0	3	40	60	100	PEC
6.	UCMG2424	Financial Analytics	3	0	0	3	40	60	100	PEC

ENVIRONMENT AND SUSTAINABILITY

S.No.	Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
			L	T	P		CA	ESE	Total	
1.	UCES2425	Sustainable Infrastructure Development	3	0	0	3	40	60	100	PEC
2.	UCES2426	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100	PEC
3.	UCES2427	Sustainable Bio Materials	3	0	0	3	40	60	100	PEC
4.	UCES2428	Materials for Energy Sustainability	3	0	0	3	40	60	100	PEC
5.	UCES2429	Green Technology	3	0	0	3	40	60	100	PEC
6.	UCES2430	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100	PEC
7.	UCES2431	Integrated Energy Planning for Sustainable Development	3	0	0	3	40	60	100	PEC
8.	UCES2432	Energy Efficiency for Sustainable Development	3	0	0	3	40	60	100	PEC



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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UENT24101	PROFESSIONAL ENGLISH - I	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To improve the communicative competence of learners • To learn to use basic grammatic structures in suitable contexts • To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text • To help learners use language effectively in professional contexts • To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.					

Unit-I	INTRODUCTION TO EFFECTIVE COMMUNICATION	(1)
What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?		
Unit-I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	(8)
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).		
Unit-II	NARRATION AND SUMMATION	(9)
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.		
Unit-III	DESCRIPTION OF A PROCESS / PRODUCT	(9)
Reading - Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).		



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Unit-IV	CLASSIFICATION AND RECOMMENDATIONS	(9)
Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions		
Unit-V	EXPRESSION	(9)
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Jeevani, Department of English, Anna University.

REFERENCES:	
1	Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3	English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5	Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	To use appropriate words in a professional context
CO2:	To gain understanding of basic grammatical structures and use them in right context.
CO3:	To read and infer the denotative and connotative meanings of technical texts
CO4:	To read and interpret information presented in tables, charts and other graphic forms
CO5:	To write definitions, descriptions, narrations and essays on various topics

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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	3	1	3	-	-	-	-
CO2	1	1	1	1	1	3	3	3	1	3	-	-	-	-
CO3	2	3	2	3	2	3	3	3	2	3	3	-	-	-
CO4	2	3	2	3	2	3	3	3	2	3	3	-	-	-
CO5	2	3	3	3	-	3	3	3	2	3	-	-	-	-
Avg.	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMAT24102	MATRICES AND CALCULUS	L	T	P	C	100
		3	1	0	4	
Course Objectives	- To develop the use of matrix algebra techniques that is needed by engineers for practical applications. - To familiarize the students with differential calculus. - To familiarize the student with functions of several variables. This is needed in many branches of engineering. - To make the students understand various techniques of integration. - To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.					

Unit-I	MATRICES	(9+3)
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.		
Unit-II	DIFFERENTIAL CALCULUS	(9+3)
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.		
Unit-III	FUNCTIONS OF SEVERAL VARIABLES	(9+3)
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.		
Unit-IV	INTEGRAL CALCULUS	(9+3)
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.		
Unit-V	MULTIPLE INTEGRALS	(9+3)
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications : Moments and centres of mass, moment of inertia.		
Total No of Periods to be Taught		60

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TEXT BOOK:

1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3	James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

1	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
3	Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4	Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6	Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015.
7	Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus ", 14th Edition, Pearson India, 2018.

COURSE OUTCOMES:

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

CO1:	Use the matrix algebra methods for solving practical problems.
CO2:	Apply differential calculus tools in solving various application problems
CO3:	Able to use differential calculus ideas on several variable functions.
CO4:	Apply different methods of integration in solving practical problems.
CO5:	Apply multiple integral ideas in solving areas, volumes and other practical problems.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	2	0	2	-	-	-
CO2	3	3	1	1	0	0	0	0	2	0	2	-	-	-
CO3	3	3	1	1	0	0	0	0	2	0	2	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	2	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	2	-	-	-
Avg.	3	3	1	1	0	0	0	0	2	0	2	-	-	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPHT24103	ENGINEERING PHYSICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To make the students effectively to achieve an understanding of mechanics. • To enable the students to gain knowledge of electromagnetic waves and its applications. • To introduce the basics of oscillations, optics and lasers. • Equipping the students to be successfully understand the importance of quantum physics. • To motivate the students towards the applications of quantum mechanics.					

Unit-I	MECHANICS	(9)
Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum – Introduction to nonlinear oscillations.		
Unit-II	ELECTROMAGNETIC WAVES	(9)
The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.		
Unit-III	OSCILLATIONS, OPTICS AND LASERS	(9)
Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO ₂ laser, semiconductor laser –Basic applications of lasers in industry.		
Unit-IV	BASIC QUANTUM MECHANICS	(9)
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
Unit-V	APPLIED QUANTUM MECHANICS	(9)
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
Total No of Periods to be Taught		45 Periods

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TEXT BOOK:

1	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.

REFERENCES:

1	R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2	Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3	K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

COURSE OUTCOMES:

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

CO1:	Understand the importance of mechanics.
CO2:	Express their knowledge in electromagnetic waves.
CO3:	Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4:	Understand the importance of quantum physics.
CO5:	Comprehend and apply quantum mechanical principles towards the formation of energy bands.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	3	3	1	1	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	2	1	-	-	-	-	-	-	-	-
Avg.	3	3	1.6	1.2	1.8	1	-	-	-	-	-	-	-	-


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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24104	ENGINEERING CHEMISTRY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To inculcate sound understanding of water quality parameters and water treatment techniques. • To impart knowledge on the basic principles and preparatory methods of nanomaterials. • To introduce the basic concepts and applications of phase rule and composites. • To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics. • To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.					

Unit-I	WATER AND ITS TREATMENT	(9)
Water: Sources and impurities, Water quality parameters: Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.		
Unit-II	NANOCHEMISTRY	(9)
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
Unit-III	PHASE RULE AND COMPOSITES	(9)
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		


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Unit-IV	FUELS AND COMBUSTION	(9)
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon foot print.		
Unit-V	ENERGY SOURCES AND STORAGE DEVICES	(9)
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles-working principles; Fuel cells: H ₂ -O ₂ fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
Total No of Periods to be Taught		Total: 45 periods

TEXT BOOK:	
1	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3	S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCES:	
1	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4	Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	To apply the knowledge of phase rule and composites for material selection requirements.
CO4:	To recommend suitable fuels for engineering processes and applications.
CO5:	To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	1	-	1	1	-	-	-	-	1	-	-
CO2	2	-	-	1	-	2	2	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	1	2	-	-	-	-	-	-	-
CO5	3	1	2	1	-	2	2	-	-	-	-	2	-	-
Avg.	2.8	1.3	1.6	1	-	1.5	1.8	-	-	-	-	1.5	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	CSE	Programme Code & Name	Common to All
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Semester-I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPST24105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the basics of algorithmic problem solving. - To learn to solve problems using Python conditionals and loops. - To define Python functions and use function calls to solve problems. - To use Python data structures - lists, tuples, dictionaries to represent complex data. - To do input/output with files in Python.					

Unit-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	(9)
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	DATA TYPES, EXPRESSIONS, STATEMENTS	(9)
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	CONTROL FLOW, FUNCTIONS, STRINGS	(9)
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	LISTS, TUPLES, DICTIONARIES	(9)
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	FILES, MODULES, PACKAGES	(9)
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, Voter's age validation, Marks range validation (0-100).		
Total No of Periods to be Taught		TOTAL: 45 Periods

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TEXT BOOK:	
1	Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:	
1	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data,,Third Edition, MIT Press 2021

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs.
CO3:	Write simple Python programs using conditionals and looping for solving problems.
CO4:	Decompose a Python program into functions.
CO5:	Represent compound data using Python lists, tuples, dictionaries etc.
CO6:	Read and write data from/to files in Python programs

Mapping of COs with POs and PSOs														
Cos / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	2	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4	2	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	1	-	2	-	-
CO6	2	2	-	-	2	-	-	-	-	1	-	2	-	-
Avg.	2	3	3	3	2	-	-	-	-	2	2	3	3	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UTAT24106	HERITAGE OF TAMIL	L	T	P	C	100
		1	0	0	1	
COURSE OBJECTIVES	• Understanding Sangam literature • Learning about the heritage of Tamil culture and the importance of rock art • Being able to recognize and identify the folk and martial art forms of Tamils • Understanding the principles of the Tamils • Understanding the contribution of Tamils to the Indian national movement and Indian culture					

UNIT 1	LANGUAGE AND LITERATURE	(3)
Language Families in India - Dravidian Languages –Tamil Classical Language - Classical Literature inTamil–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 2	HERITAGE – ROCK ART PAINTINGS TO MODERN ART–SCULPTURE	(3)
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
UNIT 3	FOLK AND MARTIAL ARTS	(3)
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
UNIT 4	THINAI CONCEPT OF TAMILS	(3)
FloraandFaunaofTamils&AhamandPuramConceptfromTholkappiyamandSangamLiterature-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 5	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	(3)
Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India — Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine — Inscriptions & Manuscripts — Print History of Tamil Books.		
Total No of Periods to be Taught		Total: 15 periods



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TEXT BOOK:

1	1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும் கல்வியியல் பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம் (தொல்லியல்துறை வெளியீடு)
4	பொருநை - ஆற்றங்கரை நாகரிகம், (தொல்லியல்துறை வெளியீடு)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB& ESCandRMRL–(in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

COURSE OUTCOMES:

பாடநெறியின் முடிவில் மாணவர்கள்

CO1:	Gain The Knowledge About Various Literatures Of Tamil
CO2:	Learn The Uniqueness Of Tamil Cultural Heritage
CO3:	Find Various Art Forms Of Tamil Nadu
CO4:	Understand The Thina Cocept In Tamil
CO5:	Distinguish The Contribution Of Tamils To Indian National Movement And Indian Culture



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Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO2	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO3	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO4	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO5	-	-	-	-	-	1	1	-	-	1	-	1	-	-
Avg.	-	-	-	-	-	1	1	-	-	1	-	1	-	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														


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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UTAT24106	தமிழர் மரபு	L	T	P	C	100
		1	0	0	1	
பாடநெறி நோக்கங்கள்	- சங்க இலக்கியத்தை புரிந்து கொள்ளுதல் - தமிழ் கலாச்சாரத்தின் பாரம்பரியத்தையும் மற்றும் பாறை ஓவியத்தின் சிறப்பினையும் கற்றுத் தெளிதல் - தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்பு கலை வடிவங்களை அங்கீகரிக்கவும் அடையாளம் காண முடியும் - தமிழர்களின் திணைக் கோட்பாடுகள் உணர்தல் - இந்திய தேசிய இயக்கம் மற்றும் இந்திய கலாச்சாரத்திற்கு தமிழர்களின் பங்களிப்பை புரிதல்					

அலகு 1	மொழி மற்றும் இலக்கியம்	(3)
இந்திய மொழிக்குடும்பங்கள் - திராவிடமொழிகள் - 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 - சிறுநிலக்கியங்கள் -தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
அலகு 2	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை சிற்பக்கலை	(3)
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் நாட்டுப்புறத் தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு		
அலகு 3	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	(3)
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஓயிலாட்டம். தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		



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அலகு 4	தமிழர்களின் திணைக் கோட்பாடுகள்	(3)
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – சங்ககால நகரங்களும் துறை முகங்களும், சங்க கால தமிழர்களின் எழுத்தறிவும் கல்வி அறிவும் மற்றும் சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி		
அலகு 5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	(3)
இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் சுயமரியாதை இயக்கம் இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு- கல்வெட்டு மற்றும் எழுத்துப் படிகள் தமிழ்ப்புத்தகங்களின் அச்ச வரலாறு.		
Total No of Periods to be Taught		Total: 15 periods

TEXT BOOK:

1	தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும் கல்வியியல்பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம் (தொல்லியல்துறை வெளியீடு)
4	பொருநை - ஆற்றங்கரை நாகரிகம், (தொல்லியல்துறை வெளியீடு)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB& ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)


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Mecheri, Salem Dt-636453, Tamilnadu



COURSE OUTCOMES:

பாடநெறியின் முடிவில் மாணவர்கள்

CO1:	தமிழ் இலக்கியங்களைப் பற்றிய அறிவைப் பெற முடியும்
CO2:	தமிழ் கலாச்சார பாரம்பரியத்தின் தனித்துவத்தைக் கற்றுக்கொள்ள முடியும்
CO3:	தமிழ்நாட்டின் பல்வேறு கலை வடிவங்களைக் கண்டறிதல்
CO4:	தமிழில் தினை கொள்கையைப் புரிந்துகொள்ளவும் முடியும்
CO5:	இந்திய தேசிய இயக்கத்திற்கும் இந்திய கலாச்சாரத்திற்கும் தமிழின் பங்களிப்பை அறிதல்

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO2	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO3	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO4	-	-	-	-	-	1	1	-	-	1	-	1	-	-
CO5	-	-	-	-	-	1	1	-	-	1	-	1	-	-
Avg.	-	-	-	-	-	1	1	-	-	1	-	1	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	CSE	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPSL2413	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C	100
		0	0	4	2	
Course Objectives	• To understand the problem solving approaches. • To learn the basic programming constructs in Python. • To practice various computing strategies for Python-based solutions to real world problems. • To use Python data structures - lists, tuples, dictionaries. • To do input/output with files in Python.					

List of Exercises/Experiments	
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)	
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).	
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)	
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)	
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)	
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)	
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)	
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)	
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)	
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)	
11. Exploring Pygame tool.	
12. Developing a game activity using Pygame like bouncing ball, car race etc.	
Total No of Periods to be Taught	60 Periods


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COURSE OUTCOMES:

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

CO1:	Develop algorithmic solutions to simple computational problems
CO2:	Develop and execute simple Python programs
CO3:	Implement programs in Python using conditionals and loops for solving problems.
CO4:	Deploy functions to decompose a Python program
CO5:	Process compound data using Python data structures.
CO6:	Utilize Python packages in developing software applications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	ANACONDA JUPITER SOFTWARE	30
2	WINDOWS 10 OS, 6GB RAM	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	2	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4	2	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	1	-	2	-	-
CO6	2	2	-	-	2	-	-	-	-	1	-	2	-	-
Avg.	2	3	3	3	2	-	-	-	-	2	2	3	3	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPCL2412	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C	100
		0	0	4	2	

PHYSICS LABORATORY : (Any Seven Experiments)

Course Objectives	- To learn the proper use of various kinds of physics laboratory equipment. - To learn how data can be collected, presented and interpreted in a clear and concise manner. - To learn problem solving skills related to physics principles and interpretation of experimental data. - To determine error in experimental measurements and techniques used to minimize such error. - To make the student as an active participant in each part of all lab exercises.
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List of Exercises / Experiments

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.	
2. Simple harmonic oscillations of cantilever.	
3. Non-uniform bending - Determination of Young's modulus	
4. Uniform bending – Determination of Young's modulus	
5. Laser- Determination of the wave length of the laser using grating	
6. Air wedge - Determination of thickness of a thin sheet/wire	
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle b) Compact disc- Determination of width of the groove using laser.	
8 .Acoustic grating- Determination of velocity of ultrasonic waves in liquids.	
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids	
10. Post office box -Determination of Band gap of a semiconductor.	
11. Photoelectric effect.	
12. Michelson Interferometer.	
13. Melde's string experiment	
14. Experiment with lattice dynamics kit.	
Total No of Periods to be Taught	30 periods


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COURSE OUTCOMES:

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

CO1:	Understand the functioning of various physics laboratory equipment.
CO2:	Use graphical models to analyze laboratory data.
CO3:	Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4:	Access, process and analyze scientific information.
CO5:	Solve problems individually and collaboratively.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Torsional pendulum with accessories	5
2.	Simple harmonic oscillations of cantilever with accessories	5
3.	Non-uniform bending - Young's modulus with accessories	5
4.	Laser- Determination of the wave length of the laser using grating with accessories	5
5.	Air wedge with accessories	5
6.	Optical fibre with accessories Compact disc with accessories	5
7.	Ultrasonic interferometer	5

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-
Avg.	3	2.4	2.6	1	1								
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy													


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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPCL2412	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C	100
		0	0	4	2	

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

Course Objectives	- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper. - To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions. - To demonstrate the analysis of metals and alloys. - To demonstrate the synthesis of nanoparticles
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List of Exercises/Experiments	
1	Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2.	Determination of types and amount of alkalinity in water sample. Split the first experiment into two
3.	Determination of total, temporary & permanent hardness of water by EDTA method.
4.	Determination of DO content of water sample by Winkler's method.
5.	Determination of chloride content of water sample by Argentometric method.
6.	Estimation of copper content of the given solution by Iodometry.
7.	Estimation of TDS of a water sample by gravimetry.
8.	Determination of strength of given hydrochloric acid using pH meter.
9.	Determination of strength of acids in a mixture of acids using conductivity meter.
10.	Conductometric titration of barium chloride against sodium sulphate (precipitation titration) .
11.	Estimation of iron content of the given solution using potentiometer
12.	Estimation of sodium /potassium present in water using flame photometer.
13.	Preparation of nanoparticles ($\text{TiO}_2/\text{ZnO}/\text{CuO}$) by Sol-Gel method
14.	Estimation of Nickel in steel.
15.	Proximate analysis of Coal
Total No of Periods to be Taught	
Total: 30 periods	

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COURSE OUTCOMES:

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

CO1:	To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2:	To determine the amount of metal ions through volumetric and spectroscopic techniques
CO3:	To analyse and determine the composition of alloys.
CO4:	To learn simple method of synthesis of nanoparticles.
CO5:	To quantitatively analyse the impurities in solution by electroanalytical techniques”

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	PH meter	15 nos
2.	Conductivity meter	15 nos
3.	Potentiometer	15 nos
4.	Flame photometer	4 nos
5.	Electronic Balance (Four digit)	1 no
6.	Hotplate with temperature controller	5 nos
7.	Hot Air Oven	1 no
8.	Muffle furnace	1 no
9.	Magnetic stirrer	2 nos

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	-	2	2	-	-	-	-	2	-	-
CO2	3	1	2	-	-	1	2	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	1	-	-	-	-	-	-	-
CO4	2	1	2	-	-	2	2	-	-	-	-	-	-	-
CO5	2	1	2	-	1	2	2	-	-	-	-	1	-	-
Avg.	2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy														

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Department	S&H	Programme Code & Name	Common to All
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Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UENL2411	ENGLISH LABORATORY	L	T	P	C	100
		0	0	2	1	
Course Objectives	• To improve the communicative competence of learners • To help learners use language effectively in academic /work contexts • To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc. • To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts. • To use language efficiently in expressing their opinions via various media.					

Unit-I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; politeness strategies-making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).		
Unit-II	NARRATION AND SUMMATION	6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities		
Unit-III	DESCRIPTION OF A PROCESS / PRODUCT	6
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.		
Unit-IV	CLASSIFICATION AND RECOMMENDATIONS	6
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation.		
Unit-V	EXPRESSION	6
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions-understanding a website-describing processes.		
Total No of Periods to be Taught		30 Periods


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ASSESSMENT PATTERN:

1.	One online / app based assessment to test listening /speaking
2.	End Semester ONLY listening and speaking will be conducted online.
3.	Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam .

COURSE OUTCOMES:

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

CO1:	To listen to and comprehend general as well as complex academic information
CO2:	To listen to and understand different points of view in a discussion
CO3:	To speak fluently and accurately in formal and informal communicative contexts
CO4:	To describe products and processes and explain their uses and purposes clearly and accurately
CO5:	To express their opinions effectively in both formal and informal discussions

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	3	3	3	3	3	-	-
CO2	3	3	3	3	1	3	3	3	3	3	3	3	-	-
CO3	3	3	3	3	1	3	3	3	3	3	3	3	-	-
CO4	3	3	3	3	1	3	3	3	3	3	3	3	-	-
CO5	3	3	3	3	1	3	3	3	3	3	3	3	-	-
Avg.	3	3	3	3	1	3	3	3	3	3	3	3	-	-

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UENT24201	PROFESSIONAL ENGLISH - II	L	T	P	C	100
		2	0	0	2	
Course Objectives	- To engage learners in meaningful language activities to improve their reading and writing skills - To learn various reading strategies and apply in comprehending documents in professional context - To help learners understand the purpose, audience, contexts of different types of writing - To develop analytical thinking skills for problem solving in communicative contexts - To demonstrate an understanding of job applications and interviews for internship and placements					

Unit-I	MAKING COMPARISONS	(6)
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases		
Unit-II	EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING	(6)
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds		
Unit-III	PROBLEM SOLVING	(6)
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences.		
Unit-IV	REPORTING OF EVENTS AND RESEARCH	(6)
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions.		
Unit-V	THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY	(6)
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.		
Total No of Periods to be Taught		30



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TEXT BOOK:

1	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2	English for Science & Technology Cambridge University Press 2021.
3	Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2	Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3	Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COURSE OUTCOMES:

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

CO1:	To compare and contrast products and ideas in technical texts.
CO2:	To identify and report cause and effects in events, industrial processes through technical texts
CO3:	To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4:	To present their ideas and opinions in a planned and logical manner
CO5:	To draft effective resumes in the context of job search.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2	3	3	-	-	-
CO2	3	3	3	3	3	3	3	3	2	3	3	-	-	-
CO3	3	3	3	3	3	3	3	3	2	3	3	-	-	-
CO4	3	3	3	3	2	3	3	3	2	3	3	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	3	-	-	-
Avg.	3	3	3	3	2.75	3	3	3	2.2	3	3	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMAT24201	STATISTICS AND NUMERICAL METHODS	L	T	P	C	100
		3	1	0	4	
Course Objectives	● This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology. ● To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems. ● To introduce the basic concepts of solving algebraic and transcendental equations. ●To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines. ● To acquaint the knowledge of various techniques and methods of solving ordinary differential equations					

Unit-I	TESTING OF HYPOTHESIS	(9+3)
Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.		
Unit-II	DESIGN OF EXPERIMENTS	(9+3)
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design.		
Unit-III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	(9+3)
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.		
Unit-IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	(9+3)
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Unit-V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	(9+3)
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.		
Total No of Periods to be Taught		60 Periods



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TEXT BOOK:

1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1.	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4.	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
6.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010

COURSE OUTCOMES:

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

CO1:	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2:	Apply the basic concepts of classifications of design of experiments in the field of agriculture
CO3:	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4:	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5:	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.



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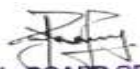
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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	0	0	0	2	0	2	-	-	-
CO2	3	3	1	1	1	0	0	0	2	0	2	-	-	-
CO3	3	3	1	1	1	0	0	0	2	0	2	-	-	-
CO4	3	3	1	1	1	0	0	0	2	0	2	-	-	-
CO5	3	3	1	1	1	0	0	0	2	0	2	-	-	-
Avg.	3	3	1	1	1	0	0	0	2	0	2	-	-	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPHT24207	PHYSICS OF MATERIALS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To make the students to understand the basics of phase diagrams and various materials preparation techniques • To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors • To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication • To familiarize the students with the theory and applications of magnetic and dielectric materials • To provide the students a sound platform towards learning about advanced materials and their applications.					

Unit-I	PREPARATION OF MATERIALS	(9)
Phases - phase rule – binary systems – tie line – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation: PVD, CVD method – Nanomaterials Preparation: wet chemical, solvothermal, sol-gel method.		
Unit-II	ELECTRICAL PROPERTIES OF MATERIALS	(9)
Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – tunneling - degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High T _c superconductors – Magnetic levitation and SQUIDS.		
Unit-III	SEMICONDUCTING PROPERTIES MATERIALS	(9)
Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative) - carrier concentration in metals - carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.		
Unit-IV	DIELECTRIC AND MAGNETIC MATERIALS	(9)
Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials.		



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Unit-V	NEW MATERIALS AND APPLICATIONS	(9)
Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses – Shape memory alloys – Copper, Nickel and Titanium based alloys – grapheme and its properties – Relaxor ferroelectrics - Biomaterials – hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – Polymer semiconductors – Photoconducting polymers.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
2	V.Raghavan. Materials Science and Engineering: A First Course. PHI Learning, 2015.
3	M.F.Ashby, P.J.Ferreira and D.L.Schodek. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, 2011.

REFERENCES:	
1	J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015.
2	D.R. Askeland and W.J.Wright. Essentials of Materials Science and Engineering, Cengage Learning, 2013.
3	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4	Jean P.Mercier, G.Zambelli and W.Kurz, Introduction to Materials Science, Elsevier, 2002.
5	Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
CO2:	Familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
CO3:	Gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
CO4:	Realize with theories and applications of dielectric and ferromagnetic materials
CO5:	Familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	2	-	-	-	-	-	-	-	-	-	-	-

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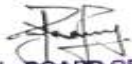
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CO3	3	-	-	1	2	1	1	-	-	-	-	-	-	-
CO4	3	-	2	1	3	-	1	-	-	-	-	-	-	-
CO5	3	2	2	2	2	1	2	-	-	-	-	-	-	-
Avg.	3	1.3	2	1.3	2.3	1	1.3	-	-	-	-	-	-	-
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Department	MECHANICAL	Programme Code & Name				114 - Mechanical	
Semester II							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UGET24201	ENGINEERING GRAPHICS		L	T	P	C	100
			2	0	4	4	
Course Objectives	1. Drawing engineering curves. 2. Drawing freehand sketch of simple objects. 3. Drawing orthographic projection of solids and section of solids. 4. Drawing development of solids 5. Drawing isometric and perspective projections of simple solids.						
CONCEPTS AND CONVENTIONS (Not for Examination) Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.							
Unit-I	PLANE CURVES						(6+12)
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.							
Unit-II	PROJECTION OF POINTS, LINES AND PLANE SURFACE						(6+12)
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.							
Unit-III	PROJECTION OF SOLIDS AND FREEHAND SKETCHING						(6+12)
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)							
Unit-IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES						(6+12)
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)							
Unit-V	ISOMETRIC AND PERSPECTIVE PROJECTIONS						(6+12)
Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three-dimensional modelling of isometric projection of simple objects by CAD Software (Not for Examination).							
Total No of Periods to be Taught				TOTAL: (L=30; P=60) 90 PERIODS			


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TEXT BOOK:

1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019
2	Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCES:

1	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.
2	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3	Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5	Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited,

COURSE OUTCOMES:

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

CO1:	Use BIS conventions and specifications for engineering drawing.
CO2:	Construct the conic curves, involutes and cycloid.
CO3:	Solve practical problems involving projection of lines.
CO4:	Draw the orthographic, isometric and perspective projections of simple solids.
CO5:	Draw the development of simple solids.

Mapping of COs with POs and PSOs

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2
Avg.	3	1	2	-	2	-	-	-	-	3	-	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial, BT – Bloom’s Taxonomy


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Department	EEE	Programme Code & Name	105-B.E EEE
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBET24201	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the basics of electric circuits and analysis - To impart knowledge in domestic wiring - To impart knowledge in the basics of working principles and application of electrical machines - To introduce analog devices and their characteristics - To introduce the functional elements and working of sensors and transducers.					

Unit-I	ELECTRICAL CIRCUITS	(9)
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems		
Unit-II	MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS	(9)
Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems. Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid		
Unit-III	ELECTRICAL MACHINES	(9)
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.		
Unit-IV	ANALOG ELECTRONICS	(9)
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters, harmonics.		
Unit-V	SENSORS AND TRANSDUCERS	(9)
Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
3	S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4	James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley, 2018

REFERENCES:

1	John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
2	Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017
4	Muhammad H.Rashid, "Spice for Circuits and electronics", 4th Edition., Cengage India, 2019.
5	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

COURSE OUTCOMES:

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

CO1:	Compute the electric circuit parameters for simple problems
CO2:	Explain the concepts of domestics wiring and protective devices
CO3:	Explain the working principle and applications of electrical machines
CO4:	Analyze the characteristics of analog electronic devices
CO5:	Explain the types and operating principles of sensors and transducers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	1	-	-	-	-	-	-	-
Avg.	2	1	1	-	-	-	1	-	-	-	-	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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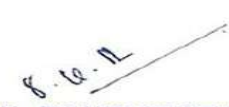
Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24201	INTRODUCTION TO CHEMICAL ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	To acquaint the students with the fundamentals of Chemical Engineering and to build their perspective in a wholesome manner.					

Unit-I	INTRODUCTION	(9)
Chemical Engineering in day to life with examples, Origin and growth of chemical Engineers in chemical process industries, unit operations and unit processes concepts, scaling up or down, units and dimensions, application of mathematics in chemical Engg, recent developments in chemical process industries		
Unit-II	INTRODUCTION TO MATERIAL AND ENERGY BALANCES	(9)
Basic concepts of material and energy balances, energy and mass transport, and kinetics of chemical reactions. Introduction to heat and mass transfer. Process flow sheeting and symbols.		
Unit-III	FLUID FLOW	(9)
Nature of fluid, Viscosity, Flow field, Conservation of mass and energy. Frictional losses, pumping of fluids. Dimensional Analysis and Correlations.		
Unit-IV	CHEMICAL ENGINEERING COMPUTER SOFTWARE TOOLS AND APPLICATIONS	(9)
Introduction to Process Engineering Design Software (HYSYS and PRO II) , Computations Using Microsoft Excel, Computer-Aided Design & Drafting, Piping and Equipment Design Software		
Unit-V	CAREER DIVERSITIES IN CHEMICAL ENGINEERING	(9)
Career Development Leading to Specialization, Chemical Engineering Job Titles/Options, Chemical and Process Engineers, Commissioning Engineer, Process Control/Automation Engineer, Process Safety Engineer, Research & Development Engineer Pharmaceutical Engineer/Pharmaceutical Process Engineer, Pipeline Engineer Chemical Manufacturing Engineer, Environment Engineer.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Anderson, L.B., Wenzel, L.A., "Introduction to Chemical Engineering", McGraw-Hill Book Company, Inc., New York (1961).
2	Pushpavanam, S., "Introduction to Chemical Engineering", PHI Learning Pvt. Ltd.(2012).
3	Ghosal, S.K., Sanyal, S.K., Datta, S., "Introduction to Chemical Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi(1997).


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REFERENCES:

1	Rao, M.G., Sittig, M., "Dryden's Outlines of Chemical Technology", East-West Press (1997).
2	Perry, R.H., Green, D.W., "Perry's Chemical Engineers' Handbook", McGraw-Hill Book Company (2008).

COURSE OUTCOMES:

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

CO1:	Correlate day to day like with the principles of chemical Engineering.
CO2:	Assess the mass and energy involved in any chemical plant.
CO3:	Have an insight into areas where Chemical Engineering plays major role.
CO4:	Carry out modelling and simulation using software tools.
CO5:	Identify their right future.
CO6:	Gain confidence and outline about the programme as a whole.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	2	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	2	2	-
CO3	3	2	3	1	-	-	-	-	-	1	-	2	2	-
CO4	3	2	3	1	1	1	1	-	-	1	1	2	2	-
CO5														
CO6	3	2	3	-	-	-	-	-	-	-	1	2		-
Avg.	3	2	3	1	-	2	1	-	-	1	1	2	2	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UTAT24201	தமிழரும் தொழில் நுட்பமும்	L	T	P	C	100
		1	0	0	1	
பாடநெறி நோக்கங்கள்	• நெசவு மற்றும் பாணை தொழில்நுட்பத்தைப் புரிந்துகொள்ளல் • சேரர்கள், சோழர்கள், பல்லவர்கள் மற்றும் நாயக்கர்களின் கட்டுமான வடிவமைப்பு தொழில்நுட்பத்தை ஒப்பிடுதல் • தமிழர்களின் பல்வேறு உற்பத்தி தொழில்நுட்ப அறிவைப் பெறுதல். • தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவை பகுப்பாய்வு செய்தல். • அறிவியல் தமிழையும் மற்றும் இணைய பயன்பாட்டையும் கற்றல்					

அலகு 1	நெசவுமற்றும்பாணைத்தொழில்நுட்பம்	(3)
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சங்ககாலத்தில் நெசவுத்தொழில், பாணைத்தொழில்நுட்பம், கருப்பு சிவப்புபாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு 2	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	(3)
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சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமான பொருட்களும், வீட்டுப் பொருட்களில் வடிவமைப்பும். சங்க காலத்தில் நடுகல்லும் சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் மாமல்லபுரச் சிற்பங்களும், கோவில்களும் சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழி பாட்டுத் தலங்கள், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் செட்டிநாட்டு வீடுகள் பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை.

அலகு 3	உற்பத்தித்தொழில்நுட்பம்	(3)
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கப்பல் கட்டும் கலை உலோகவியல் - இரும்புத் தொழிற்சாலை இரும்பை உருக்குதல், எஃகு வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் மணி உருவாக்கும் தொழிற்சாலைகள் கல்மணிகள். கண்ணாடி மணிகள் - சங்கு மணிகள் சுடுமண் மணிகள் எலும்புத் துண்டுகள் தொல்வியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	(3)
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அணை, ஏரி, குளங்கள், மதகு சோழர் காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு கால் நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் கடல்சார் அறிவு - மீன்வளம் - அறிவுசார் சமூகம் முத்து மற்றும் முத்துக் குளித்தல்.

அலகு 5	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	(3)
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அறிவியல் தமிழின் வளர்ச்சி கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் தமிழ் இணையக் கல்விக்கழகம் தமிழ் மின் நூலகம் இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத்திட்டம்.

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Total No of Periods to be Taught	Total: 15 periods
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TEXT BOOK:

1	தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும் கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் - முனைவர் இல, சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி -வைகை நதிக்கரையில் சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருநை -ஆற்றங்கரைநாகரிகம், (தொல்லியல்துறைவெளியீடு)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

REFERENCES:

1	Social Life of Tamils(Dr.K.K.Pillay)A joint publication of TNTB& ESCandRMRL-(in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publishedby: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: DepartmentofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

COURSE OUTCOMES:

பாடநெறியின் முடிவில் மாணவர்கள்

CO1:	நெசவு மற்றும் பாணை தொழில்நுட்பத்தைப் புரிந்துகொள்ள
CO2:	வடிவமைப்பு மற்றும் கட்டிட தொழில்நுட்பத்தில் தமிழர்களின் அறிவை பெறுவார்கள்
CO3:	தமிழர்களின் பல்வேறு உற்பத்தி தொழில்நுட்ப அறிவை கண்டறிவார்கள்
CO4:	தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவை விவாதிப்பார்கள்.
CO5:	இணைய பயன்பாடுகளின் அறிவியல் தமிழை பயன்படுத்திப் பார்ப்பார்கள்


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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	1	1	1	-	1	-	-
CO2	-	-	-	-	-	2	2	2	2	2	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	2	-	2	-	-
CO4	-	-	-	-	-	1	1	1	1	1	-	1	-	-
CO5	-	-	-	-	-	2	2	2	2	2	-	2	-	-
Avg.	-	-	-	-	-	2	2	2	2	2	-	2	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	EEE	Programme Code & Name	105-B.E EEE
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGEL24201	ENGINEERING PRACTICES LABORATORY	L	T	P	C	100
		0	0	4	2	
Course Objectives	• Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common house hold wood work. • Wiring various electrical joints in common household electrical wire work. • Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work. • Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.					

GROUP – A (CIVIL & ELECTRICAL)	
PART I: CIVIL ENGINEERING PRACTICES	15
PLUMBING WORK: a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household. b) Preparing plumbing line sketches. c) Laying pipe connection to the suction side of a pump d) Laying pipe connection to the delivery side of a pump. e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances. WOOD WORK: a) Sawing, b) Planning and c) Making joints like T-Joint Mortise joint and Tenon joint and Dovetail joint. Wood Work Study: a) Studying joints in door panels and wooden furniture b) Studying common industrial trusses using models.	
PART II: ELECTRICAL ENGINEERING PRACTICES	15
a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket b) Staircase wiring c) Fluorescent Lamp wiring with introduction to CFL and LED types. d) Energy meter wiring and related calculations/ calibration e) Study of Iron Box wiring and assembly f) Study of Fan Regulator (Resistor type and Electronic type using Diac /Triac /quadrac) g) Study of emergency lamp wiring/Water heater	
GROUP – B (MECHANICAL AND ELECTRONICS)	
PART III MECHANICAL ENGINEERING PRACTICES	15

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WELDING WORK: a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. b) Practicing gas welding. BASIC MACHINING WORK: a) (simple) Turning. b) (simple) Drilling. c) (simple) Tapping. ASSEMBLY WORK: a) Assembling a centrifugal pump. b) Assembling a household mixer. c) Assembling an air conditioner. SHEET METAL WORK: a) Making of a square tray FOUNDRY WORK: a) Demonstrating basic foundry operations.	
PART IV: ELECTRONIC ENGINEERING PRACTICES	15
SOLDERING WORK: a) Soldering simple electronic circuits and checking continuity. ELECTRONIC ASSEMBLY AND TESTING WORK: a) Assembling and testing electronic components on a small PCB ELECTRONIC EQUIPMENT STUDY: a) Study an elements of smart phone. b) Assembly and dismantle of LED TV. c) Assembly and dismantle of computer/ laptop	
Total No of Periods to be Taught	60

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2:	Wire various electrical joints in common household electrical wire work.
CO3:	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4:	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB

Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	1	-	-	-	-	2	2	1
CO2	3	2	-	-	1	1	-	-	-	-	2	2	1
CO3	3	2	-	-	1	1	-	-	-	-	2	2	1
CO4	3	2	-	-	1	1	-	-	-	-	2	2	1
Avg.	3	2	-	-	1	1	-	-	-	-	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy													

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Department	EEE	Programme Code & Name	105-B.E EEE
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBEL24201	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	L	T	P	C	100
		0	0	4	2	
Course Objectives	- To train the students in conducting load tests electrical machines - To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers - To train the students to measure three phase power and displacement					

List of Exercises / Experiments :	
1. Verification of ohms and Kirchhoff's Laws.	
2. Three Phase Power Measurement.	
3. Load test on DC Shunt Motor.	
4. Load test on Self Excited DC Generator	
5. Load test on Single phase Transformer .	
6. Load Test on Induction Motor .	
7. Characteristics of PN and Zener Diodes	
8. Characteristics of BJT, SCR and MOSFET	
9. Design and analysis of Half wave and Full Wave rectifiers	
10. Measurement of displacement of LVDT	
Total No of Periods to be Taught	60

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Use experimental methods to verify the Ohm's law and Kirchhoff's Law and to measure three phase power
CO2:	Analyze experimentally the load characteristics of electrical machines
CO3:	Analyze the characteristics of basic electronic devices
CO4:	Use LVDT to measure displacement

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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	1	2	-	-	1.5	2	-	-	-	-	-
CO2	2	3	1	2	-	-	1.5	2	-	-	-	-	-
CO3	2	3	1	2	-	-	1.5	2	-	-	-	-	-
CO4	2	3	1	2	-	-	1.5	2	-	-	-	-	-
Avg.	2	3	1	2	-	-	1.5	2	-	-	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGEL24202	COMMUNICATION LABORATORY	L	T	P	C	100
		0	0	4	2	
Course Objectives	- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context. - To analyse concepts and problems and make effective presentations explaining them clearly and precisely. - To be able to communicate effectively through formal and informal writing. - To be able to use appropriate language structures to write emails, reports and essays - To give instructions and recommendations that are clear and relevant to the context					

Unit-I		12
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal & semi-formal).		
Unit-II		12
Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.		
Unit-III		12
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.		
Unit-IV		12
Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article		
Unit-V		12
Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application(Cover letter + Curriculum vitae)-writing recommendations.		
Total No of Periods to be Taught		60 periods



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COURSE OUTCOMES:

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

CO1:	Speak effectively in group discussions held in a formal/semi formal contexts.
CO2:	Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
CO3:	Write emails, letters and effective job applications.
CO4:	Write critical reports to convey data and information with clarity and precision
CO5:	Give appropriate instructions and recommendations for safe execution of tasks

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	3	3	3	3	3	3	3	-	-
CO2	2	3	3	3	1	3	3	3	3	3	3	3	-	-
CO3	2	2	3	3	1	3	3	3	3	3	3	3	-	-
CO4	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO5	3	3	3	3	3	3	3	3	3	3	3	3	-	-
Avg.	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMAT24303	DIFFERENTIAL EQUATIONS	L	T	P	C	100
		3	1	0	4	
Course Objectives	• To acquaint the students with Differential Equations which are significantly used in engineering problems • To introduce the basic concepts of PDE for solving standard partial differential equations. • To acquaint the knowledge of various techniques and methods of solving ordinary differential equations. • To understand the knowledge of various techniques and methods of solving various types of partial differential equations. • To understand the finite methods for time dependent partial differential equations.					

Unit-I	ORDINARY DIFFERENTIAL EQUATIONS	(12)
Higher order linear differential equations with constant coefficients – Particular integrals: Operator methods, Method of variation of parameters, Methods of undetermined coefficients– Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.		
Unit-II	PARTIAL DIFFERENTIAL EQUATIONS	(12)
Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.		
Unit-III	NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS	(12)
Explicit Adams-Bashforth Techniques, Implicit Adams-Moulton Techniques, Predictor-Corrector Techniques, Finite difference methods for solving two-point linear boundary value problems, Orthogonal Collocation method.		
Unit-IV	FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS	(12)
Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes.		
Unit-V	FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION	(12)
Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – First order hyperbolic equations – method of characteristics, different explicit and implicit methods; Wave equation: Explicit scheme- Stability of above schemes.		
Total No of Periods to be Taught		60


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TEXT BOOK:

1	Grewal. B.S, "Higher Engineering Mathematics", 44 th Edition, Khanna Publications, New Delhi, 2018.
2	Gupta S.K., "Numerical Methods for Engineers" (Third Edition), New Age Publishers, New Delhi , 2015.
3	M K Jain , S R K Iyengar , R K Jain, "Computational Methods for Partial Differential Equations", New Age Publishers, New Delhi , , 1994.

REFERENCES:

1	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
2	Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
3	Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.

COURSE OUTCOMES:

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

CO1:	Apply various methods of solving differential equation which arise in many application problems.
CO2:	Understand how to solve the given standard partial differential equations.
CO3:	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO4:	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
CO5:	Familiar with various methods to solve time dependent partial differential equations.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	0	0	0	1	2	2	1	2
CO2	3	3	2	2	1	2	0	2	1	2	0	3	1	1
CO3	3	3	3	2	2	1	0	0	0	0	2	1	2	1
CO4	3	3	2	1	2	1	0	0	0	0	2	2	1	0
CO5	3	3	2	1	1	1	0	0	0	0	2	2	1	1
Avg.	3	3	2.4	1.8	1.6	1	0	0.4	0.2	0.6	1.6	2	1.2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24301	BASIC MECHANICAL ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines					

Unit-I	LAWS OF THERMODYNAMICS	(9)
Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Third law of Thermodynamics - Statement.		
Unit-II	HEATING AND EXPANSION OF GASES	(9)
Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.		
Unit-III	AIR STANDARD CYCLES	(9)
Carnot cycle; Otto cycle; Diesel cycle; Dual combustion Cycle- Derivations and problems.		
Unit-IV	I.C. ENGINES, STEAM AND ITS PROPERTIES AND TEAM	(9)
Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption. Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle. Steam turbines – Impulse and Reaction types - Principles of operation.		
Unit-V	SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALNCING	(9)
Definition of Kinematic Links, Pairs and Kinematic Chains; Flywheel-Turning moment Diagram; Fluctuation of Energy. Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types. Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Nag, P.K., "Engineering Thermodynamics ", IInd Edition, Tata McGraw Hill Publishing Co., Ltd., 1995
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2	Rajput, R .K, “Thermal Engineering”, Laxmi publications (P) Ltd, 2001.
3	Khurmi R.S., and Gupta J.K, “Theory of Machines”, Eurasia Publishing House (P) Ltd., 2004.

REFERENCES:

1	Bhaskaran, K.A., and Venkatesh, A., “Engineering Thermodynamics “,Tata McGraw Hill, 1973.
2	Khurmi R.S., and Gupta J.K, “Thermal Engineering”, S.Chand & Company (P) Ltd.,2001.
3	Kothandaraman and Dhomkundwar,”: A course in Thermal Engineering (SI Units)”, Dhanpat Rai and Sons, Delhi (2001)
4	Pandya A. and Shah, “ Theory of Machines “, Charatakar Publishers, 1975.
5	Smith, “Chemical Thermodynamics “, Reinhold Publishing Co., 1977.

COURSE OUTCOMES:

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

CO1:	Understand the basic concepts and Laws of thermodynamics and its applications.
CO2:	Understand the various processes with its derivation and gaining knowledge of various processes in Chemical Industries.
CO3:	Understand the various thermodynamic cycles with its derivation.
CO4:	Understand the thermal engineering equipments like IC engine etc with its performance, and rankine cycle.
CO5:	Understand the drives used to transmit power from one shaft to another belt drive, chain drive, gear drive etc and flywheel.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	2	3	2	2	3	3	2	-
CO2	2	2	3	2	2	2	3	3	2	3	3	3	2	2
CO3	2	2	2	-	-	2	2	3	2	2	3	2	2	2
CO4	3	3	3	2	-	-	-	2	2	2	2	2	-	2
CO5	3	3	3	2	3	3	3	2	2	3	3	2	2	2
Avg.	3	3	3	2	2	2	2	2	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCET24302	MECHANICS OF SOLIDS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge on designing the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor for the study on process equipment design and drawing.					

Unit-I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	(9)
Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poisson's ratio.		
Unit-II	TRANSVERSE LOADING ON BEAMS	(9)
Beams –support conditions–types of Beams –transverse loading on beams–shear force and bending moment in beams–analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. in beams and their applications– S.F.& B.M. diagrams.		
Unit-III	DEFLECTIONS OF BEAMS	(9)
Double integration method – Macaulay's method –Area – moment theorems for computation of slopes and deflections in beams.		
Unit-IV	STRESSES IN BEAMS	(9)
Theory of simple bending – assumptions and derivation of bending equation ($M/I = F/Y = E/R$)– analysis of stresses in beams–load carrying capacity of beams–proportioning beam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.		
Unit-V	TORSION AND COLUMNS	(9)
Torsion of circular shafts – derivation of torsion equation ($T/J = \tau/R = C\theta/L$) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts– stepped shafts – shafts fixed at both ends– stresses in helical springs–deflection of springs–spring constant. Axially loaded short columns–columns of unsymmetrical sections– Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Junarkar, S. B., Mechanics of Structure Vol.1, 21st Edition, Character Publishing House, Anand, Indian, (1995).
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2	William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series.
3	McGraw Hill International Editions, Third Edition, 1994.

REFERENCES:

1	Elangovan A. ,Thinma Visailyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.
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COURSE OUTCOMES:

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

CO1:	Understand the basic concepts of stress, strain and deformation of solids.
CO2:	Understand the concept of transverse loading on statistically deterministic beams.
CO3:	Understand the concept of slope and deflection in beams through Double Integration.
CO4:	Understand the stress distribution concept like bending and shear stresses in beams and leaf springs
CO5:	Understand the stress and deformation in shafts, analysis of columns by Euler's theory and effect of eccentricity.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	3	1	2	3	3	2	-
CO2	2	2	3	2	2	2	3	3	2	3	3	3	2	2
CO3	2	2	2	-	-	2	2	3	2	2	3	2	2	2
CO4	3	3	3	2	-	-	-	2	2	2	2	2	-	2
CO5	3	3	3	2	3	3	3	2	2	3	3	2	2	2
Avg.	2	2	3	2	2	2	2	2	2	2	3	2	2	2

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24303	CHEMICAL PROCESS CALCULATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To enable the students to acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.					

Unit-I		(9)
Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.		
Unit-II		(9)
Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.		
Unit-III		(9)
Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.		
Unit-IV		(9)
Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances		
Unit-V		(9)
Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.		
Total No of Periods to be Taught	45	

TEXT BOOK:

1	Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition, Tata McGraw-Hill (2004)
2	Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Eighth Edition, Prentice Hall Inc., 2012



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3	Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", 5 th Edn., John Wiley & Sons, New York, 2005.
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REFERENCES:

1	Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers, Second edition, 2004.
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COURSE OUTCOMES:

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

CO1:	Understand the concepts of dimensional consistency and effective application of units and dimensions.
CO2:	Analyze a problem statement and balance the material flowing through single and various operations
CO3:	Understand the gas behaviour and its properties
CO4:	Understand general energy balance, simplify and apply to open and closed systems
CO5:	Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO2	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO3	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO4	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO5	2	3	2	3	3	2	1	1	1	1	1	2	3	1
Avg.	2	3	2	3	3	2	1	1	1	1	1	2	3	1

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24304	FLUID MECHANICS FOR CHEMICAL ENGINEERS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To enable the students to acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics of fluid flow for through pipes and porous medium, flow measurement and fluid machineries					

Unit-I		(9)
Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion		
Unit-II		(9)
Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.		
Unit-III		(9)
The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies.		
Unit-IV		(9)
Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.		
Unit-V		(9)
Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans.		
Total No of Periods to be Taught	45	

TEXT BOOK:

1	Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Third Edition, McGraw-Hill, (2017).
2	McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2017
3	Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 9th Edition“, John Wiley, 2021



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REFERENCES:

1	White, F.M., "Fluid Mechanics ", IV Edition, McGraw-Hill Inc., 1999.
2	James O Wilkes and Stacy G Bike, "Fluid Mechanics for Chemical Engineers' Prentice Hall, PTR ,(International series in Chemical Engineering) (1999)

COURSE OUTCOMES:

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

CO1:	Understand the fundamental properties of fluids, stress-strain relationship in fluids, and its characteristics under static conditions and establish force balance in static systems.
CO2:	Apply Bernouli principle, Navier - Stokes equation and compute pressure variation in static fluid.
CO3:	Use of dimensional analysis to derive relationships among process or system variables. Further they would develop dimensionless groups that help in scale-up studies.
CO4:	Understand the different types of flow conditions in fixed bed and fluidized beds.
CO5:	Describe function of flow metering devices, apply Bernoulli equation to determine the performance of flow-metering devices and also analyze the performance aspects of fluid machinery such as pumps, compressors and valves.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO2	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO3	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO4	2	3	2	3	3	2	1	1	1	1	1	2	3	1
CO5	2	3	2	3	3	2	1	1	1	1	1	2	3	1
Avg.	2	3	2	3	3	2	1	1	1	1	1	2	3	1

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24305	CHEMICAL PROCESS INDUSTRIES	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge on various aspects of production engineering and make the student understand the practical methods of production in a chemical factory.					

Unit-I	SULFUR, SULFURIC ACID AND CEMENT	(9)
Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.		
Unit-II	FERTILIZER INDUSTRY	(9)
Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries, Phosphoric acid, Single Super Phosphate, DAP, MAP and NPK – Potassium chloride, Potassium Sulphate – Liquid Fertilizers – Bio Fertilizers.		
Unit-III	PULP, PAPER, SUGAR AND STARCH INDUSTRIES	(9)
Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations.		
Unit-IV	PETROLEUM AND PETRO CHEMICAL INDUSTRIES	(9)
Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Butadiene – Chemicals from Aromatics - Benzene, Toluene and Xylene.		
Unit-V	FUEL AND INDUSTRIAL GASES	(9)
Fuel Gases – Natural gas, Liquefied natural gas, Synthesis Gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen – Argon.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2	Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, Second edition 2013.

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REFERENCES:

1	Austin, G.T., Shreve's "Chemical Process Industries", 5 th ed., McGraw-Hill, 2017.
2	Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd .

COURSE OUTCOMES:

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

CO1:	Understand the various unit operations and processes with their symbols
CO2:	Understand the various chemical reactions involved in the process
CO3:	Students will know to draw the process Flow sheet and understand the major engineering problems encountered in the processes.
CO4:	To learn manufacturing processes of organic and Inorganic Chemicals and its applications.
CO5:	Students will understand the role of chemical Engineering in the process plants.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	-	-	-	1	2	3	2	
CO2	2	2	3	3	2	1	1	1	1	-	2	2	2	
CO3	3	2	2	2	2	1	1	1	-	1	1	1	1	
CO4	2	3	3	2	3	1	-	-	-	2	2	2	2	
CO5	2	3	3	2	3	1	1	-	1	1	2	2	3	
Avg.	2	2	3	2	2	1	1	1	1	1	2	2	2	

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24301	BASIC MECHANICAL ENGINEERING LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	- Impart practical knowledge in operating IC engines and conduct experiments. - To make the students understand the test procedures in testing material for engineering applications					

List of Exercises/Experiments	
1. Port timing diagram	
2. Valve timing diagram	
3. Study of 2,4 stroke I C Engines	
4. Load test on 4-stroke petrol engine	
5. Performance test on 4-stroke single cylinder diesel engine	
6. Performance test on 4-stroke twin cylinder diesel engine	
7. Heat balance test on diesel engines	
8. Tension test	
9. Compression test	
10. Deflection test	
11. Hardness test (Rockwell and Brinell)	
12. Spring test	
13. Torsion test	
14. Impact test	
Total No of Periods to be Taught	45

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Determine Brake power, Indicated power and frictional power of single cylinder diesel engines
CO2:	Determine Brake power, Indicated power and frictional power of twin cylinder diesel engines.
CO3:	Determine Brake power, Indicated power and frictional power of single cylinder petrol engines.
CO4:	Evaluate the heat distribution from engine and preparing heat balance chart.
CO5:	Estimate the engine performance with mechanical loading.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Single cylinder diesel engine coupled with Electrical loading	1
2	Single cylinder diesel engine coupled with Electrical loading with temperature indicators	1
3	Single cylinder slow speed diesel engine coupled with Mechanical loading	1
4	Twin cylinder diesel engine coupled with Electrical loading with Heat balance test setup	1
5	Single cylinder petrol engine coupled with Electrical Loading	1
6	Two stroke IC Engine model	1
7	Four stroke IC Engine model	1
8	Small IC Engine models for study	1
9	UTM and Hardness test apparatus	1

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	2	3	2	2	3	3	2	-
CO2	2	2	3	2	2	2	3	3	2	3	3	3	2	2
CO3	2	2	2	-	-	2	2	3	2	2	3	2	2	2
CO4	3	3	3	2	-	-	-	2	2	2	2	2	-	2
CO5	3	3	3	2	3	3	3	2	2	3	3	2	2	2
Avg.	3	3	3	2	2	2	3	2	2	2	3	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24302	TECHNICAL ANALYSIS LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	To learn basic principles involved in estimation and characterization of industrially important materials					

List of Exercises/Experiments	
I. Soap Analysis	
a. Estimation of total fatty acid	
b. Estimation of percentage alkali content	
II. Oil Analysis	
a. Estimation of free acid	
b. Determination of Saponification value	
c. Determination of iodine value	
III. Cement Analysis	
a. Estimation of Silica content	
b. Estimation of mixed oxide content	
c. Estimation of calcium oxide content	
d. Estimation of calcium oxide by rapid method	
IV. Coal Analysis	
a. Estimation of Sulphur present in coal	
b. Ultimate analysis of coal	
c. Proximate analysis of coal	
V. Analysis of Bleaching Powder	
a. Estimation of available chlorine	
VI. Analysis of Glycerol	
Estimation of purity of glycerol	
VII. Analysis of fuels	
a. Flash point	
b. Fire point	
c. Cloud point	
d. Pour point	



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e. Aniline point.

Total No of Periods to be Taught

45

COURSE OUTCOMES:

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

CO1:	Understand the estimation and analysis of Soap.
CO2:	Understand the estimation and analysis of Cement Analysis
CO3:	Understand the estimation and analysis of Coal Analysis
CO4:	Understand the estimation and analysis of Analysis of Glycerol
CO5:	Understand the estimation and analysis of Analysis of fuels

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Silica Crucible	20
2	Heating Mantle	3
3	Muffle Furnace	1
4	Hot air oven	1
5	Desiccator	5
6	Vacuum pump	1
7	Condenser	10
8	Pensky martens closed cup apparatus	1
9	Cleveland Open cup apparatus	1
10	Cloud point apparatus	1
11	Saybolt Viscometer	1
12	Redwood Viscometer	1
13	Bomb Calorimeter	1
14	COD reflux	1
15	Orsat apparatus	1
16	UV-Vis Spectrophotometer	1



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Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	3	3	2	2	3	2	3	2	2	3	3	2	-
CO2	1	2	3	2	2	2	3	3	2	3	3	3	2	1
CO3	1	2	2	-	-	2	2	3	2	2	3	2	2	1
CO4	1	3	3	2	-	-	-	2	2	2	2	2	-	1
CO5	1	3	3	2	3	3	3	2	2	3	3	2	1	2
Avg.	1	3	3	2	2	2	3	2	2	2	3	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														


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Department	Mechanical	Programme Code & Name	114 - Mechanical
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Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
USD24301	SOFT SKILL 1	L	T	P	C	100
		2	0	0	0	
Course Objectives	1. To understand oneself and manage own emotions					
	2. To include the Grooming and mannerism					
	3. To know different methods for faster numerical computations					
	4. To learn logical reasoning skills.					
	5. To Enhance Problem – Solving Skills					

Unit-I	NUMBER SYSTEM/PHONETICS	(6)
Introduction –Discussing Divisibility Rule-HCF –LCM –Decimal Fraction Introduction-Standard Phonetic Alphabet-Introduction to vowel & Consonant accent neutralization		
Unit-II	AVERAGE AND DIRECTION SENSE/ONE WORD SUBSTITUTES	(6)
Introduction-Basic Problem in Average-Direction Sense Problem Introduction-The One which can be substituted for the given word/Sentence.		
Unit-III	TIME AND WORK/PERSONAL COMMUNICATION	(6)
Basic Concept of Time and Work-Efficiency Related Sums on Time and Work Day to day conversation with family members-Neighbors-Friends-Relatives		
Unit-IV	PROFIT AND LOSS/PUBLIC SPEAKING	(6)
Introduction-Problem on Profit and Loss Introduction –Anchoring /Master of ceremony –Welcome address – Proposing vote of Thanks- Introducing Speaker – Conducting Meetings- Making Announcements		
Unit-V	AREA, SURFACE AREA AND VOLUME PROBLEMS/ERROR CORRECTION	(6)
Introduction about the Area Problems – Area, Surface Area and Volume for Square Rectangle –Triangle, Cylinder Introduction –Spot the Error in the sentence and correct it.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Training And Placement Book [TKEC]
2	Quantitative Aptitude by R. S. Aggarwal

REFERENCES:

1	R.S. Aggarwal," Quantitative Aptitude", Seventh edition, S.Chand Publication.
2	http://www.mastguru.com/arithmetric-aptitude-questions-answers
3	https://prepinsta.com

COURSE OUTCOMES:

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

CO1:	Practice manners and etiquettes in day-to-day life.
CO2:	Be confident and motivated to plan the activities according to personality types.
CO3:	Build Confidence in Mathematics.
CO4:	Solve mathematical problems by applying logical thinking.
CO5:	Apply different techniques for faster calculations.

Mapping of COs with POs and PSOs

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	2	-	-	-	-	-	3	3	1
CO2	2	2	2	2	1	2	-	-	-	-	-	2	3	2
CO3	3	2	2	2	1	1	-	-	-	-	-	1	2	3
CO4	3	3	2	2	1	1	-	-	-	-	-	2	1	3
CO5	2	1	2	1	3	2	-	-	-	-	-	2	2	3
Avg.	2.4	1.8	2	1.6	1.4	1.6	-	-	-	-	-	2	2.2	2.4

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMAT24401	TRANSFORM TECHNIQUES	L	T	P	C	100
		3	1	0	4	
Course Objectives	- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems. - 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 transform techniques used in wide variety of situations. - To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated. - 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	VECTOR CALCULUS	(12)
Gradient and directional derivative – Divergence and curl - Irrotational and solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and applications in evaluating line, surface and volume integrals.		
Unit-II	FOURIER SERIES	(12)
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	FOURIER TRANSFORMS	(12)
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.		
Unit-IV	LAPLACE TRANSFORMS	(12)
Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		
Unit-V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	(12)
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.		



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Total No of Periods to be Taught	60
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TEXT BOOK:	
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.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2:	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3:	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4:	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5:	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	0	0	0	2	1	2	2	1
CO2	3	3	2	2	1	2	0	1	0	2	0	3	2	1
CO3	3	2	1	2	1	1	1	0	0	3	0	2	2	2
CO4	3	3	3	1	0	0	0	0	0	1	0	1	2	1
CO5	3	3	2	2	1	1	0	2	1	2	0	3	1	2
Avg.	3	2.8	2.2	1.6	0.8	1	0.2	0.6	0.2	2	0.2	2.2	1.8	1.4
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24401	MASS TRANSFER I	L	T	P	C	100
		3	0	0	3	
Course Objectives	Learn and determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallizers.					

Unit-I	MOLECULAR DIFFUSION	(9)
Introduction to mass transfer operations. Molecular diffusion in gases, liquids and solids. Diffusivity measurement and prediction; multi-component diffusion.		
Unit-II	CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER	(9)
Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.		
Unit-III	HUMIDIFICATION OPERATIONS	(9)
Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.		
Unit-IV	DRYING	(9)
Drying – Equilibrium. Classification of dryers, batch drying – Mechanism and time of cross through circulation drying, theoretical estimation of drying rate and time. Continuous dryers – material and energy balance. Advance drying techniques such as freeze drying, microwave drying.		
Unit-V	CRYSTALLIZATION	(9)
Crystal geometry. Equilibrium, yield and purity of products, theory of super saturation, nucleation and crystal growth, classification of crystallizers, design of batch crystallizers and continuous crystallizers.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Treybal, R. E., “Mass Transfer Operations”, 3rd Edition, McGraw-Hill, 2017
2	Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3	Narayanan K.V. and Lakshmikutty, B “Mass Transfer – Theory and Applications”, 1 st Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, 2014.

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REFERENCES:

1	McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7 th Edn, McGraw-Hill, 2005.
2	Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II, 5th Edition, Asian
3	Seader J.D. and Henley E.J., "Separation Process Principles", 4th Ed., John Wiley, 2016

COURSE OUTCOMES:

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

CO1:	Understand the fundamentals, types and mechanism of mass transfer operations
CO2:	Understand the theories of mass transfer and the concept of inter-phase mass transfer
CO3:	Understand the basics of humidification process and its application
CO4:	Understand the concept and mechanism of drying operations
CO5:	Understand the concept of crystallization process and identification of suitable crystallizer and formulate to solve material balances for unit operations such as humidification, drying and crystallization operations.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	3	1	-	-
CO2	3	3	3	-	-	-	-	-	-	-	3	1	-	-
CO3	3	3	3	-	-	-	-	-	-	-	3	1	-	-
CO4	3	3	3	-	-	1	1	-	-	-	3	1	1	-
CO5	3	3	3	-	-	1	1	-	-	-	3	1	1	-
Avg.	3	3	3	-	-	1	-	-	-	-	3	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24402	MECHANICAL OPERATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge in the field of particle size reduction and also construction and working of equipment's used for mechanical operations.					

Unit-I	PARTICLE CHARACTERIZATION AND MEASUREMENT	(9)
General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.		
Unit-II	PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT	(9)
Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top-down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, palletization, and flocculation. Fundamentals of particle generation.		
Unit-III	PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM)	(9)
Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging		
Unit-IV	FILTRATION AND FILTRATION EQUIPMENTS	(9)
Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.		
Unit-V	MIXING AND PARTICLE HANDLING	(9)
Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2	Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.
3	Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2 nd Edn., John Wiley & Sons, 1994.
4	Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 3rd Edition.

REFERENCES:

1	Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2	Christie J. Geankoplis, Transport processes and unit operations.
3	Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications.
4	Martin Rhodes, Introduction to Particle Technology, Second Edition.

COURSE OUTCOMES:

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

CO1:	Understand and determine various properties of particulates
CO2:	Gain Preliminary understanding on Size Reduction and Size Enlargement
CO3:	Understand various separation and purification techniques employed in solid particles
CO4:	Enhance their knowledge on Filtration Process
CO5:	Understand Handling, Storage and Transportation of Solids and Obtain knowledge on various unit operations and their applications

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	-	3	3	2	2	3	3	1
CO2	3	2	2	2	2	1	-	1	2	2	2	2	3	1
CO3	3	2	2	3	3	3	2	1	2	3	2	2	3	3
CO4	2	2	2	1	1	2	1	1	1	1	1	2	2	1
CO5	2	2	3	2	1	3	1	1	1	2	2	1	1	3
Avg.	3	3	3	3	2	2	1	2	2	3	3	3	3	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24403	CHEMICAL ENGINEERING THERMODYNAMICS - I	L	T	P	C	100
		3	0	0	3	
Course Objectives	Learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.					

Unit-I		(9)
Terminologies of thermodynamics, the variables and quantities of thermodynamics, characteristics of systems and processes, energy classifications, point and path functions, energy in transition work and heat. Zeroth law; temperature scales.		
Unit-II		(9)
The first law of thermodynamics, statements of first law for the flow and non-flow processes. PVT behaviour of fluids; Mathematical representation of PVT behaviour; generalized compressibility factor correlation; generalized equations of state		
Unit-III		(9)
Joule's experiment, energy balance for closed systems, mass and energy balance for open systems, Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume, Third law of thermodynamics, entropy from a microscopic point of view.		
Unit-IV		(9)
Thermodynamic properties – internal energy, enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations – Maxwell relations – partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams.		
Unit-V		(9)
Thermodynamic aspects of compression, expansion processes and duct flow of compressible fluids, steam power plant.		
Total No of Periods to be Taught	45	

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TEXT BOOK:

1	Smith J.M., VanNess,H.C., &Abbot M.C, " Introduction to Chemical Engineering Thermodynamics" ,McGraw Hill VII Edition 2009.
2	Kyle B.G., "Chemical and Process Thermodynamics", Pearson International third Edition.
3	Rao Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005.

REFERENCES:

1	Sandler,S.I., "Chemical and Engineering Thermodynamics", IV Edition, Wiley, 2006.
2	Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt.Ltd, 2nd edition, 2013.
3	Kevin Douglas, Fundamentals of Chemical Engineering Thermodynamics, Timothy Anderson, 2015.

COURSE OUTCOMES:

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

CO1:	Understand the fundamental concepts of thermodynamics and its related functions.
CO2:	Relate PVT behaviour of fluids and understand the real gas behavior.
CO3:	Apply second law and analyze the feasibility of system/devices.
CO4:	Analyze the thermodynamic property relations and their application to fluid flow.
CO5:	Develop the significance of thermodynamic potentials and their use in the analysis of processes and formulate thermodynamic formulations and the working of compressors and expanders.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	2	-	-	2	1	-	3	-	-
CO2	3	2	-	2	1	-	-	1	1	-	1	-	-	-
CO3	3	3	3	2	-	2	1	3	2	1	1	3	2	2
CO4	2	2	2	2	2	1	2	3	1	2	2	2	3	2
CO5	2	2	1	-	-	1	2	1	1	2	-	-	2	1
Avg.	3	3	3	2	2	2	2	2	3	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24404	HEAT TRANSFER	L	T	P	C	100
		3	0	0	3	
Course Objectives	Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students.					

Unit-I		(9)
Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer ; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres - Thermal conductivity measurement-effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Transient heat conduction.		
Unit-II		(9)
Concepts of heat transfer by convection - Natural and forced convection, Hydrodynamic and thermal Boundary layers; analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Colburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate.		
Unit-III		(9)
Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers.		
Unit-IV		(9)
Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.		
Unit-V		(9)
Evaporation- single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring's rule. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Holman, J. P., 'Heat Transfer ', 10th Edn., McGraw Hill, 2010.

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2	Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984.
3	Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.
4	B.K. Dutta, Heat transfer principles and applications, PHI Learning PVT Ltd, 2016.

REFERENCES:

1	McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 6 th Edn., McGraw-Hill, 2001.
2	Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

COURSE OUTCOMES:

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

CO1:	Familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state.
CO2:	Understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows.
CO3:	Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers.
CO4:	The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation.
CO5:	Students will understand radiative heat transfer including blackbody radiation and Kirchoff's law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	-	-	-	-	1	2	2	2
CO2	2	2	3	3	2	1	1	1	1	1	-	1	2	2
CO3	3	2	2	2	2	1	1	1	1	-	1	1	1	1
CO4	2	2	3	2	3	1	-	-	-	-	2	2	1	1
CO5	2	3	3	2	3	1	-	1	-	1	1	2	2	1
Avg.	3	2	3	3	2	1	1	1	1	1	1	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	CHEM	Programme Code & Name	203 - CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UESST24401	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C	100
		2	0	0	2	
Course Objectives	- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation. - To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters. - To facilitate the understanding of global and Indian scenario of renewable and non renewable resources, causes of their degradation and measures to preserve them. - To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management. - To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.					

Unit-I	ENVIRONMENT AND BIODIVERSITY	(6)
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	(6)
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 (OHASMS). Environmental protection, Environmental protection acts.		
Unit-III	RENEWABLE SOURCES OF ENERGY	(6)
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	(6)
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		


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Unit-V	SUSTAINABILITY PRACTICES	(6)
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- Socioeconomical and technological change		
Total No of Periods to be Taught		30 Periods

TEXT BOOK:	
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 . edition 2010.
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, Third Edition, 2015.
5	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.


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COURSE OUTCOMES:

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

CO1:	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2:	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3:	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4:	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5:	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	3	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	-	-	-	-	2	-	-	-
CO3	3	-	1	-	-	2	-	-	-	-	2	-	-	-
CO4	3	2	1	1	-	2	-	-	-	-	2	-	-	-
CO5	3	2	1	-	-	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1	1	-	2.4	-	-	-	-	1.8	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24401	FLUID MECHANICS LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	To enable the students to learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.					

List of Exercises/Experiments	
1. Viscosity measurement of non-Newtonian fluids	
2. Calibration of constant and variable head meters	
3. Calibration of weirs and notches	
4. Open drum orifice and draining time	
5. Flow through straight pipe	
6. Flow through annular pipe	
7. Flow through helical coil and spiral coil	
8. Losses in pipe fittings and valves	
9. Characteristic curves of pumps (Centrifugal / Gear / Reciprocating)	
10. Pressure drop studies in packed column	
11. Hydrodynamics of fluidized bed	
12. Drag coefficient of solid particle	
Total No of Periods to be Taught	45

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Identify and characterize of flow patterns and regimes
CO2:	Calibrate flow measurement devices
CO3:	Correlate the difference between fixed and fluidized bed columns and its application.
CO4:	Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties
CO5:	Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Viscometer	1
2	Venturi meter	1
3	Orifice meter	1
4	Rotameter	1
5	Weir and Notches	1
6	Open drum with orifice	1
7	Pipes and fittings	1
8	Helical and spiral coils	1
9	Centrifugal pump / Gear pump / Reciprocating	1
10	Packed column	1
11	Fluidized bed	1

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	3	2	1
CO2	-	3	3	3	-	-	-	-	-	-	-	3	3	2
CO3	-	3	3	3	-	-	-	-	-	-	-	3	2	1
CO4	3	3	3	-	2	-	-	-	-	-	-	3	2	1
CO5	3	3	3	3	2	2	-	-	3	2	2	3	3	2
Avg.	3	3	3	3	2	2	-	-	3	2	2	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24402	MECHANICAL OPERATIONS LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Develop sound practical knowledge on different types of mechanical operations equipments.					

List of Exercises/Experiments	
1. Sieve analysis	
2. Batch filtration studies using a Leaf filter	
3. Batch filtration studies using a Plate and Frame Filter press	
4. Characteristics of batch Sedimentation	
5. Reduction ratio in Jaw Crusher	
6. Reduction ratio in Ball mill	
7. Separation characteristics of Cyclone separator	
8. Reduction ratio of Roll Crusher	
9. Separation characteristics of Elutriator	
10. Reduction ratio of Drop weight crusher	
11. Size separation using Sub-Sieving	
Total No of Periods to be Taught	45

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Determine the size analysis in solid- solid separation systems.
CO2:	Capability to select different solid - fluid separation equipments.
CO3:	Evaluate the size reduction and various crushing parameters.
CO4:	Estimate the separation characteristics.
CO5:	Understand the technical methods related to unit operations in process plant.



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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Sieve shaker	1
2	Leaf filter	1
3	Plate and Frame Filter Press	1
4	Sedimentation Jar	1
5	Jaw Crusher	1
6	Ball Mill	1
7	Cyclone Separator	1
8	Roll Crusher	1
9	Elutriator	1
10	Drop Weight Crusher	2
11	Sieves.	Set of 5

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	3	2	1	2	3	2	1
CO2	3	3	2	3	1	3	2	2	1	2	1	3	3	2
CO3	3	3	2	2	1	2	1	2	1	1	1	3	2	1
CO4	3	2	2	1	1	1	1	2	2	2	2	3	2	1
CO5	3	3	2	3	3	3	3	3	3	2	3	3	3	2
Avg.	3	3	2	2	2	3	2	3	2	2	2	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
USD24401	SOFT SKILL 2	L	T	P	C	100
		2	0	0	0	
Course Objectives	1.	To learn the Number Series and develop Social Communication				
	2.	To learn Time Speed Distance and develop work glossary				
	3.	To develop Grammar usage and learn to solve problems on ages.				
	4.	To develop Personality development & Logical thinking.				
	5.	To learn email ethics and logical ability.				

Unit-I	NUMBER SERIES & SOCIAL COMMUNICATION	(6)
Introduction-Number Series-Simplification Introduction-Telephone Calls (Formal and Informal)- Colleagues in work spot -Sharing jokes.		
Unit-II	TIME, SPEED AND DISTANCE & WORK GLOSSARY	(6)
Introduction-Problem on Time & Distance-Problem on Trains Heteronym-Homonym-Homophone-Activity Based Learning.		
Unit-III	AGES AND SYLLOGISM & GRAMMER USAGE	(6)
Problem on Ages-Syllogism-Problem on Sets and Venn Diagram Introduction-Parts of Speech-Noun-Verb-Pronoun-Adverb-Adjective-Conjunction-Preposition-Interjection.		
Unit-IV	LOGICAL REASONING & PERSONALITY DEVELOPMENT	(6)
Introduction-Alphabet Coding and Decoding –Coding with Numbers-Seating Arrangement Analyzing Strength and Weakness-Time Management.		
Unit-V	FINGURE SERIES, ODD ONE OUT, VOCABULARY & EMAIL ETIQUETTE	(6)
Introduction-Figure Matrix-Figure Series Prefix-Suffix-Synonyms-Antonyms-Word Analogy.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Training And Placement Book [TKEC]
2	Quantitative Aptitude By R.S.Aggarwal

REFERENCES:

1	R.S. Aggarwal, "Quantitative Aptitude", Seventh edition, S.Chand Publication.
2	http://www.mastguru.com/arithmetic-aptitude-questions-answers
3	https://prepinsta.com

COURSE OUTCOMES:

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

CO1:	Cultural Competence
CO2:	Apply concepts real world scenarios
CO3:	Identify and explain grammatical concepts
CO4:	Identify and analyze logical fallacies
CO5:	Students will understand the importance of professionalism in email communication

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	-	1	2	2	-	-	-	1	-	-	-
CO2	2	2	2	-	1	1	1	-	-	-	1	-	-	-
CO3	2	2	2	-	1	1	1	1	1	-	1	-	-	-
CO4	2	2	2		1	1	1	1	1	-	1	-	-	-
CO5	2	2	2	-	1	1	1	1	1	-	1	-	-	-
Avg.	2	2	1.6	-	1	1.2	1.2	0.6	0.6	-	1	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24501	CHEMICAL ENGINEERING THERMODYNAMICS II	L	T	P	C	100
		3	0	0	3	
Course Objectives	Understand the phase Behaviour of fluids under different PVT conditions and apply them for practical purposes. The course will render a comprehensive understanding of theory and application of solution thermodynamics.					

Unit-I	SOLUTION THERMODYNAMICS	(6)
Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures, pure species and liquids.		
Unit-II	PHASE EQUILIBRIA	(12)
Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry's law, fugacity, Phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.		
Unit-III	CORRELATION AND PREDICTION OF PHASE EQUILIBRIA	(12)
Vapor-Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data		
Unit-IV	CHEMICAL REACTION EQUILIBRIA	(9)
Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.		
Unit-V	REFRIGERATION	(6)
Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, Evaluation and performance of vapor compression and gas refrigeration cycles.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Smith J.M., Van Ness, H.C., & Abbot M.C., "Introduction to Chemical Engineering thermodynamics", McGraw Hill VII Edition 2009
2	Kyle B.G., "Chemical and Process Thermodynamics", Pearson International third Edition 2015.
3	Rao Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005



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REFERENCES:

1	Sandler, S.I., "Chemical and Engineering Thermodynamics", IV Edition, Wiley, 2006.
2	Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt.Ltd, 2nd edition, 2013.

COURSE OUTCOMES:

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

CO1:	Understand the systematic development of new class of properties to describe real mixtures.
CO2:	Develop the idea of chemical potential to derive the idea of phase equilibria.
CO3:	Understand the relationship connecting T, P and composition originating from the concept of chemical potential and fugacity coefficient.
CO4:	Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.
CO5:	Analyze the ideal and actual vapor-compression refrigeration cycle and evaluate the performance of Liquefaction processes.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	3	3	3	-
CO2	3	3	3	3	2	-	-	-	-	-	3	3	3	-
CO3	3	3	3	2	3	-	-	-	-	-	3	3	3	-
CO4	3	3	3	3	3	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	3	-	-	-	-	-	3	3	3	-
Avg.	3	3	3	3	3	-	-	-	-	-	3	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24502	MASS TRANSFER-II	L	T	P	C	100
		3	0	0	3	
Course Objectives	Impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit their properties according to the changed environment. Also, to design absorber and stripper, distillation column, extraction and leaching equipment and adsorber.					

Unit-I	ABSORPTION	(9)
Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage wise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multi component absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.		
Unit-II	DISTILLATION	(9)
Vapour liquid equilibria - Raoult's law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation.		
Unit-III	LIQUID-LIQUID EXTRACTION	(9)
Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction.		
Unit-IV	LEACHING	(9)
Solid-liquid equilibria- leaching equipment for batch and continuous operations, calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and countercurrent leaching, stage calculations, stage efficiency.		
Unit-V	ADSORPTION, ION EXCHANGE AND MEMBRANE SEPARATION PROCESSES	(9)
Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbents, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill,2017.
2	Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3	Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1998.
4	B. K. Dutta., "Mass Transfer and separation processes, Prentice Hall, 2006

REFERENCES:

1	McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw-Hill, 2017.
2	Seader J.D. and Henley E.J., "Separation Process Principles", 2nd Ed., John Wiley, 2006.
3	King, C.J., "Separation Processes", 2nd Edn., Tata McGraw-Hill 1980

COURSE OUTCOMES:

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

CO1:	Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process.
CO2:	Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower
CO3:	Apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid extraction process
CO4:	Describe core principles of leaching, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation
CO5:	Understand the concept of adsorption techniques, various isotherms and ion exchange Process and Formulate to solve mass and energy balances for unit operations such as absorption, distillation, extraction, leaching, adsorption and other separation processes

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	1	1	-	1	-	3	3	2	2
CO2	3	3	3	-	1	1	1	-	1	-	3	3	2	2
CO3	3	3	3	-	1	1	1	-	1	-	3	3	2	2
CO4	3	3	1	-	1	1	1	-	1	-	3	3	2	2
CO5	3	2	1	-	1	1	1	-	1	-	3	3	2	2
Avg.	3	3	2	-	1	1	1	-	1	-	3	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24501	COMPUTATIONAL CHEMICAL ENGINEERING LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Solve chemical engineering problems form core courses using Excel, MATLAB, Polymath / problem solving software tool and chemical process simulation software tool.					

List of Exercises/Experiments	
1. Friction factor, pressure drop, minimum fluidization velocity calculations	
2. Settling velocity, drag coefficient, Reynolds number estimations	
3. Equation of state, activity coefficient, VLE data, equilibrium conversion calculations	
4. Empirical equation in fluid flow, heat and mass transfer operations	
5. Solving a simple flow sheet by simultaneous approach	
6. One, two and three dimensional heat conduction equations	
7. Differential equation for reactors in series, non isothermal reactors, dispersion models, gravity tank	
8. Partial differential equation involved in heat transfer, mass transfer, reaction engineering	
9. First order and second order system in control system	
10. Simulation of heat exchangers, Distillation, Absorber, Extraction column, reactors.	
11. Simulation of process plant/simple flow sheet	
Total No of Periods to be Taught	30

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Solving chemical engineering problems using different tools available in the excel software.
CO2:	Solving simultaneous equation and differential equation using polymath
CO3:	Solving simultaneous equation and differential equation using Matlab
CO4:	Simulation of simple chemical process with controller using simulink tool
CO5:	Estimation of fluid property and understand the unit operation simulation using process simulation tool



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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Computers with Excel Software , Process simulation software tool	15

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1	-	-	-	3	3	1
CO2	3	3	3	3	3	-	-	1	-	-	-	3	3	2
CO3	3	3	3	3	3	1	-	1	-	-	-	3	3	1
CO4	3	3	3	3	3	1	1	1	-	-	-	3	3	1
CO5	3	2	3	3	3	1	1	1	-	-	-	3	3	2
Avg.	3	3	3	3	3	1	1	1	-	-	-	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24502	HEAT TRANSFER LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Develop sound practical knowledge for students on different types of heat transfer equipments					

List of Exercises/Experiments

1. Measurement of Thermal Conductivity of metal rod
2. Performance studies on Cooling Tower
3. Batch drying kinetics using Tray Dryer
4. Heat transfer in Open Pan Evaporator
5. Boiling Heat Transfer
6. Heat Transfer through Packed Bed
7. Heat Transfer in a Double Pipe Heat Exchanger
8. Heat Transfer in a Bare and Finned Tube Heat Exchanger
9. Heat Transfer in a Vertical and Horizontal Condenser
10. Heat Transfer in Helical Coils
11. Heat Transfer in Agitated Vessels
12. Heat transfer studies in Stefan - Boltzmann apparatus

Total No of Periods to be Taught

45

COURSE OUTCOMES:

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

CO1:	Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipments.
CO2:	Estimate the heat transfer rate and heat transfer co-efficient
CO3:	To perform heat transfer operation and to compare observed with predicted performance.
CO4:	Evaluate the performance/calculate the parameters in heat transfer equipments
CO5:	Collect and analyse the heat transfer data practically and Conduct experiments to solve complex engineering problems effectively as an individual as well as team work



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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Thermal Conductivity Apparatus	1
2	Cooling Tower	1
3	Tray Dryer	1
4	Open Pan Evaporator	1
5	Packed Bed	1
6	Double Pipe Heat Exchanger	1
7	Bare and Finned Tube Heat Exchanger	1
8	Vertical and Horizontal Condenser	1
9	Agitated Vessels and Helical Coils	1
10	Stefan - Boltzmann apparatus	1

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	2	3	2	2	3	3	-
CO2	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO3	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO4	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO5	3	3	3	3	2	1	1	2	3	2	2	3	3	-
Avg.	3	3	3	3	2	1	1	2	3	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCSI24501	SUMMER INTERNSHIP	L	T	P	C	100
		0	0	0	1	
Course Objectives	• Get connected with industry/ laboratory/research institute • Get practical knowledge on production process in the industry and develop skills to solve related problems • Develop skills to carry out research in the research institutes/laboratories					

List of Exercises/Experiments

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

Total No of Periods to be Taught	2 WEEKS
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COURSE OUTCOMES:

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

CO1:	Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute.
CO2:	Analysis of industrial / research problems and their solutions.
CO3:	Documenting of material specifications, machine and process parameters, testing parameters and results.
CO4:	Preparing of Technical report and presentation.

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Department	Mechanical	Programme Code & Name	114 - Mechanical
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UIDL24001	IDEA LAB	L	T	P	C	100
		0	0	2	1	
Course Objectives	• To learn all the skills associated with the tools and inventory associated with the IDEA Lab. • To familiarize with PCB design and prototyping • To explore design software and laser cutting for fabrication • To perform basic turning operation on a lathe machine • To introduce basic 3D modeling and additive manufacturing					

List of Exercises/Experiments	
1.	To study the working principles and operation of wood lathe machine.
2.	To Study the 3D 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
3.	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
4.	Making of Models Using CNC Wood Router
5.	3D Printing of Scanned Geometry Using FDM, SLA Printer, 3D Printing of Scanned Geometry
Total No of Periods to be Taught	30 periods

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Apply basic design thinking principles to conceptualize and develop simple prototypes using digital fabrication tools such as 3D printers, scanners, and PCB machines.
CO2:	Demonstrate the ability to operate modern prototyping equipment like laser cutters, CNC machines, and lathes to fabricate mechanical and electronic components.
CO3:	Integrate mechanical design, electronics, and fabrication techniques to develop interdisciplinary solutions for real-world problems through hands-on experimentation


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	PCB Prototyping Machines	01 No
2	CNC Wood Router	01 No
3	CO ₂ Laser Cutter	01 No
4	3D Printer	05 No
5	3D Scanner	02 No

Mapping of COs with POs and PSOs														
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	1	3	1	-	-	-	-	-	-	-	-
CO2	2	2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	2	3	2	-	-	-	-	-	-	-	-
Avg.	2	2	2	2	3	2	-	-	-	-	-	-	-	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
USD24501	SOFT SKILL 3	L	T	P	C	100
		2	0	0	0	
Course Objectives	1. To learn the Number Problem, Square and Cube Problems. 2. To learn Analytical and Interview Skills. 3. To develop Skills in Business Aptitude and Resume Building. 4. To develop Skills in Data Interpretation and Sufficiency. 5. To improve Mathematical Skill on Probability and Basic Grammer					

Unit-I	PROBLEMS ON NUMBERS & GROUP DISCUSSION	(6)
Introduction-Problem on Numbers –Square root Problems- Cube Root-Surds and Indices GD Introduction –GD gauge –Company’s Perspective-Preparation.		
Unit-II	ANALYTICAL REASONING &INTERVIEW SKILLS	(6)
Introduction, Problems on Analytical and Reasoning-Nonverbal Reasoning Introduction for Interview Skill-Before the Interview, During the Interview, After the Interview.		
Unit-III	BUSINESS APTITUDE & RESUME BUILDING	(6)
Introduction-Problem Percentage-Problem on Partnership Purpose of Resume Building –Types-Includes-Formal-Sample-Tips.		
Unit-IV	DATA INTERPRETATION AND SUFFICIENCY/BLOOD RELATION	(6)
Introduction-Table Charts-Bar Charts – Pie Charts- Line Charts-Data Sufficiency Introduction of Blood Relation-Objectives-Relation Ships –Example-Exercise		
Unit-V	PERMUTATION & COMBINATIONS, PROBABILITY/GRAMMER	(6)
Introduction - Problem on Permutation & Combination-Problems on Probability, Comparison of Ranks Introduction of Basic Grammar-Punctuation & Spelling.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Training And Placement Book [TKEC]
2	Quantitative Aptitude by R. S. Aggarwal

REFERENCES:

1	R.S. Aggarwal, "Quantitative Aptitude", Seventh edition, S. Chand Publication.
2	http://www.mastguru.com/arithmetic-aptitude-questions-answers
3	https://prepinsta.com

COURSE OUTCOMES:

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

CO1:	Advanced Mathematical Skills.
CO2:	Complex Problem-Solving Skill.
CO3:	Build Confidence in Mathematics.
CO4:	Solve mathematical problems by applying logical thinking.
CO5:	Apply different techniques for faster calculations.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	-	-	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	-	3	3	2
CO3	3	2	2	1	1	3	-	-	-	-	-	2	3	2
CO4	3	3	2	2	2	2	-	-	-	-	-	3	3	2
CO5	2	2	2	1	3	3	-	-	-	-	-	2	2	3
Avg.	2.8	2.4	2.2	1.8	1.8	2.4	-	-	-	-	-	2.6	2.8	2.2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24601	CHEMICAL REACTION ENGINEERING I	L	T	P	C	100
		3	0	0	3	
Course Objectives	Learn reaction kinetics, types of reactors, design of reactors, understand the isothermal, non isothermal operation of reactors and gain knowledge about non ideal reactors.					

Unit-I		(9)
Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis. Half-life calculation. Temperature dependent rate expression		
Unit-II		(9)
Ideal reactor classification. Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors, and size comparison of reactors.		
Unit-III		(9)
Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.		
Unit-IV		(9)
Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.		
Unit-V		(9)
The residence time distribution for chemical reactors, residence time functions and relationship between them in reactor; Models for non-ideal reactors, conversion in non-ideal reactors.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	O. Levenspiel, Chemical Reaction Engineering , Third Edition, John Wiley 2006
2	H.S. Fogler, Elements of Chemical Reaction Engineering, Fourth Edition, Prentice Hall of India, 2008
3	Coughanowr, D. R., & Leblanc, S. E. (2017). Introductory concepts. Process Systems Analysis and Control, 3rd Ed, 1-6.

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REFERENCES:

1	L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press , 2013
2	G.Fronment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 3 rd edition,2010
3	J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981

COURSE OUTCOMES:

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

CO1:	Understand the kinetics of homogenous reaction.
CO2:	Develop performance equation and determine the conversion for different reactors.
CO3:	Understand the reactor arrangement in series and parallel configuration.
CO4:	Understand the design of reactor for multiple reactions.
CO5:	Understand the non-isotherm operation of the reactor and gain knowledge on the residence time distribution function and analyze the non-ideality in the reactor.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	-	2	2	2	2	3	3	2
CO2	3	3	3	2	3	3	-	-	-	2	2	3	3	-
CO3	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO4	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO5	3	3	3	2	2	-	-	-	-	2	2	3	3	-
Avg.	3	3	3	2	2	2	-	-	-	2	2	3	3	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24602	PROCESS DYNAMICS AND CONTROL	L	T	P	C	100
		3	0	0	3	
Course Objectives	Determine possible control objectives, input variables (manipulated variables and disturbances), model the dynamic behaviour of a process, design PID controllers, frequency response and analyze stability of closed loop and open loop systems.					

Unit-I		(9)
Introduction to Chemical Process Control, Mathematical description of chemical processes, Formulating Process Models, Laplace Transforms, Properties of Laplace Transforms, Solution of ODE using Laplace Transforms, Standard input forcing functions, State – Space representation, transform domain models, Impulse response models, Inter relationship between process model forms		
Unit-II		(9)
Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag, FOPDT Model, Skogestad's rule for FOPDT and SOPDT, Lead- Lag systems		
Unit-III		(9)
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, control valves, transient response of closed-loop control systems and their stability, Root locus diagram.		
Unit-IV		(9)
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings, Nyquist Stability Criterion		
Unit-V		(9)
Introduction to advanced control systems, cascade control, feed forward control, Controllers for Inverse response Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Stephanopoulos, G. (2015). Chemical process control, 3rd Ed New Jersey: Prentice hall.
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2	Ogunnaike, B. A., & Ray, W. H. (1997). Process dynamics, modeling, and control (Vol. 1). New York: Oxford University Press.
3	Coughanowr, D. R., & Leblanc, S. E. (2017). Introductory concepts. Process Systems Analysis and Control, 3rd Ed, 1-6.

REFERENCES:

1	Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle IV, F. J. (2016). Process dynamics and control. John Wiley & Sons.
2	Bequette, B. W. (2003). Process control: modeling, design, and simulation. Prentice Hall Professional.
3	Riggs, J. B., & Karim, M. N. (2007). Chemical and Bio-process Control: James B. Riggs, M. Nazmul Karim. Prentice Hall.
4	Luyben, W. L., Tyréus, B. D., & Luyben, M. L. (1998). Plantwide process control (Vol. 43). New York: McGraw-Hill.

COURSE OUTCOMES:

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

CO1:	Understand the need to develop mathematical description of a chemical process as a Prerequisite to process design and to control the process.
CO2:	Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.
CO3:	Represent a physical system using FOPDT model and estimate parameters in FOPDT model.
CO4:	Convert a process and instrumentation diagram to a control block diagram.
CO5:	Understand Frequency response of control systems and tune the PID controllers and appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	-	2	2	2	2	3	3	2
CO2	3	3	3	2	3	3	-	-	-	2	2	3	3	-
CO3	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO4	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO5	3	3	3	2	2	-	-	-	-	2	2	3	3	-
Avg.	3	3	3	2	2	2	-	-	-	2	2	3	3	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24601	PROCESS CONTROL LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.					

List of Exercises/Experiments	
1. Response of first order system	
2. Response of second order system	
3. Response of Non-Interacting level system	
4. Response of Interacting level system	
5. Open loop study on a thermal system	
6. Closed loop study on a level system	
7. Closed loop study on a flow system	
8. Closed loop study on a thermal system	
9. Tuning of a level system	
10. Tuning of a pressure system	
11. Tuning of a thermal system	
12. Flow co-efficient of control valves	
13. Characteristics of different types of control valves	
14. Closed loop study on a pressure system	
15. Tuning of pressure system	
16. Closed loop response of cascade control system	
17. Optimum Controller Tuning using Ziegler Nichols method	
Total No of Periods to be Taught	45

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Able to determine the response of a first order and second order system for various input
CO2:	Able to determine the response of a interacting and non- interacting system for various input

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CO3:	Understand the difference between an open loop and closed loop system
CO4:	Understand the concept of three classical controller P, PI, PID controller
CO5:	Understand the concept of stability and tuning of a system

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	U tube manometer with controller	1
2	Interacting Tank	1
3	Non Interacting Tank	1
4	Open loop control system	1
5	Closed loop control system	1
6	ON/OFF controller	1
7	Control valve characteristics	1
8	Pressure Tuner	1
9	Temperature Tuner	1
10	Proportional Controller	1
11	Flow Transmitter	1
12	Level Transmitter	1
13	Cascade control system	1

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1	1	1	1	1	2	3	1
CO2	3	3	2	3	3	2	1	1	1	1	1	2	3	1
CO3	3	3	2	3	3	2	1	1	1	1	1	2	3	1
CO4	3	3	2	3	3	2	1	1	1	1	1	2	3	1
CO5	3	3	2	3	3	2	1	1	1	1	1	2	3	1
Avg.	3	3	2	3	3	2	1	1	1	1	1	2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Sixth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24602	MASS TRANSFER LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Develop sound practical knowledge for students on different types of mass transfer equipment's					

List of Exercises/Experiments

1. Separation of binary mixture using Simple distillation	
2. Separation of binary mixture using Steam distillation	
3. Separation of binary mixture using Packed column distillation	
4. Measurement of diffusivity	
5. Liquid-liquid extraction	
6. Drying characteristics of forced draft dryer	
7. Adsorption studies	
8. Cross current leaching studies	
9. Surface evaporation	
10. Wetted wall column	
11. Solid Liquid mass transfer studies	
12. Water purification using ion exchange columns	
13. Mass transfer characteristics of Rotating disc contactor	
14. Estimation of mass/heat transfer coefficient for cooling tower	
15. Demonstration of Gas – Liquid absorption	
Total No of Periods to be Taught	45

COURSE OUTCOMES:

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

CO1:	Determine the diffusivity practically and compare the results with the empirical correlations.
CO2:	Estimate the mass transfer rate and mass transfer co-efficient
CO3:	Evaluate the performance/calculate the parameters in different distillation processes
CO4:	Evaluate the performance/calculate the parameters in leaching and extraction operations

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CO5:	Estimate the drying characteristics
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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Simple distillation setup	1
2	Steam distillation setup	1
3	Packed column	1
4	Liquid-liquid extractor	1
5	Forced draft dryer	1
6	Wetted wall column	1
7	Rotating disc contactor	1
8	Cooling tower	1
9	Absorption column	1
10	Diffusion Cell	1
11	Surface Evaporation setup	1

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	-	-	2	-	-	2	3	3	-
CO2	3	3	-	2	-	-	-	2	-	-	2	3	3	-
CO3	3	3	-	2	-	-	-	2	-	-	2	3	3	-
CO4	3	3	-	2	-	-	-	2	-	-	2	3	3	-
CO5	3	3	-	3	-	-	-	2	-	-	2	3	3	-
Avg.	3	3	-	3	-	-	-	2	-	-	2	3	3	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMP24601	MINIPROJECT	L	T	P	C	100
		0	0	4	2	
Course Objectives	The objective of mini project is to enable students to work in groups of not more than three members in each group on a project involving analytical, experimental, design, simulation or combination of these in the area chemical or allied engineering.					

List of Exercises/Experiments

The student shall carry out a 'mini project work in the sixth semester. This Mini project work carries 2 credits. The student is given an option to carry out this mini project work either in the college or in an industry or in a research laboratory or in a higher learning institution. The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. The project work will be carried out under supervision of a project guide from the department. In case of student carrying out the project work outside the college, an external guide from the relevant organization shall be assigned in addition to the internal guide from the department. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

Total No of Periods to be Taught

60 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply class room theory by collecting literature pertaining to the purpose project
CO2:	Demonstrate the ability to work in teams
CO3:	Write technical documents and make oral presentations related to the work completed.
CO4:	Manage a project within a stipulated time period
CO5:	Apply professional ethics and responsibilities.



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Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	0	0	0	0	0	0	0	2	-
CO2	3	3	3	2	0	0	0	1	0	0	0	0	2	-
CO3	3	3	3	2	0	2	0	0	1	0	0	0	2	-
CO4	3	3	3	2	0	0	0	0	0	0	0	0	2	-
CO5	3	3	3	2	0	0	0	0	0	0	0	0	2	-
Avg.	3	3	3	2	0	2	0	1	1	0	0	0	2	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														


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Department	Mechanical	Programme Code & Name	114-Mechanical
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Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
USD24601	SOFT SKILL 4	L	T	P	C	100
		2	0	0	0	
Course Objectives	1.	To learn the essence of Ratio and Proportion.				
	2.	To learn a problem related to Simple Interest and Compound Interest.				
	3.	To develop Skills in Solving Problems Related to Boats and Streams.				
	4.	To develop Skills in solving Problems Related to Height and Distance.				
	5.	To improve a Skill in Solving Problem on Allegation or Mixture.				

Unit-I	RATIO AND PROPORTION, PIPES AND CISTERNS	(6)
Introductions - Pipes & Outlet Problem - Problem on Ratio & Proportion.		
Unit-II	SIMPLE INTEREST AND COMPOUND INTEREST & SPEAKING ACTIVITY	(6)
Introduction-Simple Interest-Compound Interest-Different Rules-Present worth.		
Unit-III	BOAT AND STREAM, CALENDAR & LOGICAL ARRANGEMENT OF WORDS	(6)
Introduction-Upstream & Downstream Problems-Problems on Calendar Introduction of Classification-Logical Arrangement of Words.		
Unit-IV	HEIGHT AND DISTANCE, CLOCK	(6)
Introduction-Trigonometry Formulas- Angle of Elevation-Angle of Depression –Problem on Clock.		
Unit-V	ALLIGATION OR MIXTURE, STATEMENT & CONCLUSION	(6)
Introduction – Alligation -Mean Price-Rule of Allegation-Problem on Mixture Introduction to Statement and Conclusion –Exercise for Statement and Conclusion.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Training And Placement Book [TKEC]
2	Quantitative Aptitude By R.S.Aggarwal

REFERENCES:

1	R.S. Aggarwal, "Quantitative Aptitude", Seventh edition, S.Chand Publication.
2	http://www.mastguru.com/arithmetric-aptitude-questions-answers
3	https://prepinsta.com

COURSE OUTCOMES:

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

CO1:	Advanced Mathematical Skills.
CO2:	Complex Problem-Solving.
CO3:	Data Analysis.
CO4:	Real World Applications.
CO5:	Mathematical concepts on Statement and Conclusion.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	2	1	1	3	3	2	2
CO2	3	3	3	3	2	1	1	2	2	2	3	3	3	3
CO3	2	2	2	3	3	1	1	2	2	2	2	2	3	2
CO4	3	2	3	2	2	2	1	2	2	2	3	3	2	2
CO5	3	3	2	2	2	1	2	2	2	1	3	3	2	3
Avg.	3	2.4	2.4	2.4	2	1.2	1.2	2	1.8	1.6	2.8	2.8	2.4	2.4

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24701	CHEMICAL REACTION ENGINEERING II	L	T	P	C	100
		3	0	0	3	
Course Objectives	Learn gas solid non catalytic, gas solid catalytic and fluid- fluid reaction and apply the knowledge for the reactor design.					

Unit-I		(9)
Gas solid non catalytic reaction. Reaction kinetics, Shrinking Core Model and Progressive conversion model, Controlling resistances (diffusion through gas film, ash layer and chemical reaction controlling), rate controlling steps; time for Complete Conversion for Single and Mixed Sizes, design of fluid –particle reactors.		
Unit-II		(9)
Catalysis and adsorption: physical properties of catalyst, surface area, void volume, solid density, volume determination, catalyst classification and preparation, catalyst promoters, catalyst inhibitors, catalyst poisons. Adsorption Isotherms Freundlich and Langumir isotherms.		
Unit-III		(9)
Gas solid catalytic reaction: steps in catalytic reaction, Single site, dual site mechanisms, Langmuir Hinshelwood, Eley Rideal, Rate controlling steps. Experimental methods for determining rate, differential, integral reactor and reactor design.		
Unit-IV		(9)
Diffusion within Catalyst Particle, Mass and Heat Transfer Within Catalyst Pellets, Effectiveness Factor, Thiele Modulus, Effectiveness factor for non isothermal condition.		
Unit-V		(9)
Fluid Fluid reaction. Kinetics and design of Fluid- Fluid Reactions. Rate equation, Kinetic regimes for absorption combined with chemical reaction. Various cases of mass transfer with chemical reaction , Factors to select the contactor, Tower Reactor Design.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981
2	O. Levenspiel, Chemical Reaction Engineering , Third Edition, John Wiley 2006
3	H.S. Fogler, Elements of Chemical Reaction Engineering, Fourth Edition, Prentice Hall of India,2008

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REFERENCES:

1	Lanny D. Schmidt The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2004
2	L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press , 2013
3	G.F. Froment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 3rd edition,2010.

COURSE OUTCOMES:

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

CO1:	Understand the gas solid non catalytic reaction and different models for non catalytic reaction.
CO2:	Understand catalyst, catalyst preparation, property estimation and isotherm study.
CO3:	Understand the gas solid catalytic reaction and their mechanism.
CO4:	Design of catalytic reactor for gas solid reaction.
CO5:	Understand the concepts of effectiveness factor, Thiele modulus and the concept of Mass Transfer and Mass transfer with reaction for fluid reaction and tower design.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	2	-	-	-	-	3	3	3	-
CO2	3	1	3	2	2	-	-	-	-	-	3	3	3	-
CO3	3	3	3	2	-	1	-	-	-	-	3	3	3	-
CO4	3	3	3	2	2	2	-	-	-	-	3	3	3	-
CO5	3	2	3	2	-	1	-	-	-	-	3	3	3	-
Avg.	3	3	3	2	2	2	-	-	-	-	3	3	3	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHT24702	TRANSPORT PHENOMENA	L	T	P	C	100
		3	0	0	3	
Course Objectives	Describe mass, momentum and energy transport at molecular, microscopic and macroscopic level to determine velocity, temperature and concentration profiles.					

Unit-I	MOMENTUM TRANSPORT	(9)
Viscosity, temperature and pressure effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, shell momentum balance method, Shear stress and velocity distributions in falling film, circular tube, annulus, slit.		
Unit-II	ENERGY TRANSPORT	(9)
Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance method, Energy flux and temperature distribution in solids and laminar flow with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.		
Unit-III	MASS TRANSPORT	(9)
Diffusivity, temperature and pressure effect on diffusivity, Fick's law, mechanism of mass transport, shell mass balance method, Mass flux and concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst.		
Unit-IV	EQUATIONS OF CHANGE AND THEIR APPLICATIONS	(9)
Momentum: Equations of continuity, motion and mechanical energy (Isothermal), Energy: Equation of energy (non-isothermal). Mass: Equations of change (multi-component), equations of continuity for each species, equation of energy (multi-component). Solutions of momentum, heat and mass transfer problems discussed under shell balance by applications of equation of change, dimensional analysis of equations of change.		
Unit-V	TRANSPORT IN TURBULENT FLOWS AND ANALOGIES	(9)
Comparison of laminar and turbulent flows, time-smoothed equations of change, empirical expressions. Comparison of laminar and turbulent hydrodynamics, thermal and concentration boundary layer and their thicknesses. Development and applications of analogies between momentum, heat and mass transfer.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Bird, R. B., Stewart, W. E. and Lighfoot, E. W., "Transport Phenomena", 2nd Edn., John Wiley, 2006.
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2	Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1987.
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REFERENCES:

1	Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer", 5 th Edition. John Wiley, New York, 2008.
2	Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.
3	C. J. Geankopolis, "Transport Processes in Chemical Operations", 3rd Edn., Prentice Hall of India, New Delhi, 1993.

COURSE OUTCOMES:

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

CO1:	Understand the mechanisms of momentum, heat and mass transfer each at molecular, micro and macro levels.
CO2:	Develop mathematical models to determine transfer fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.
CO3:	Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate equations of change.
CO4:	Apply the equation of change for different coordinate systems and solve of momentum, mass and heat transport problems.
CO5:	Apply the concepts of dimensional analysis and scale factors for equation of change for different coordinate systems and analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	1	3	3	-
CO2	3	3	3	2	2	-	-	1	-	-	1	3	3	-
CO3	3	3	3	1	1	-	-	1	-	-	1	3	3	-
CO4	3	3	3	2	1	-	-	1	-	-	1	3	3	-
CO5	3	3	3	2	1	-	-	1	-	-	1	3	3	-
Avg.	3	3	3	2	1	-	-	1	-	-	1	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MBA	Programme Code & Name	COMMON TO ALL
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGET24707	HUMAN VALUES AND ETHICS	L	T	P	C	100
		2	0	0	2	
Course Objectives	- To create awareness about values and ethics enshrined in the Constitution of India - To sensitize students about the democratic values to be upheld in the modern society. - To inculcate respect for all people irrespective of their religion or other affiliations. - To instill the scientific temper in the students' minds and develop their critical thinking. - To promote sense of responsibility and understanding of the duties of citizen.					

Unit-I	DEMOCRATIC VALUES	(6)
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement. Reading Text: Excerpts from John Stuart Mills' On Liberty		
Unit-II	SECULAR VALUES	(6)
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani		
Unit-III	SCIENTIFIC VALUES	(6)
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper. Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R		
Unit-IV	SOCIAL ETHICS	(6)
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices. Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari		
Unit-V	SCIENTIFIC ETHICS	(6)
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society. Reading Text: Excerpt from American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer by Kai Bird and Martin J. Sherwin.		
Total No of Periods to be Taught		30 Periods

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TEXT BOOK:

1	Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCES:

1	The Non religious: Understanding Secular People and Societies, Luke W.Galen Oxford University Press, 2016.
2	Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3	The Oxford Handbook of Secularism, John R.Shook,OxfordUniversityPress,2017.
4	The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5	Research Methodology for Natural Sciences by SoumitroBanerjee,IIScPress,January2022

COURSE OUTCOMES:

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

CO1:	Identify the importance of democratic, secular and scientific values in harmonious functioning of social life.
CO2:	Practice democratic and scientific values in both their personal and professional life.
CO3:	Find rational solutions to social problems.
CO4:	Behave in an ethical manner in society.
CO5:	Practice critical thinking and the pursuit of truth.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	3	0	0	0	3	0	0	0
CO2	0	0	0	0	0	3	3	0	0	0	3	0	0	0
CO3	0	0	0	0	0	3	3	0	0	0	3	0	0	0
CO4	0	0	0	0	0	3	3	0	0	0	3	0	0	0
CO5	0	0	0	0	0	3	3	0	0	0	3	0	0	0
Avg.	0	0	0	0	0	3	3	0	0	0	3	0	0	0

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24701	CHEMICAL REACTION ENGINEERING LABORATORY	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Develop sound practical knowledge for students on different types of reactors.					

List of Exercises/Experiments	
1. Kinetic studies in a Batch reactor	
2. Kinetic studies in a Plug flow reactor	
3. Kinetic studies in a CSTR	
4. Kinetic studies in a Packed bed reactor	
5. Kinetic studies in a PFR followed by a CSTR	
6. RTD studies in a PFR	
7. RTD studies in a Packed bed reactor	
8. RTD studies in a CSTR	
9. Studies on micellar catalysis	
10. Study of temperature dependence of rate constant using CSTR.	
11. Kinetic studies in Sono chemical reactor	
12. Studies on Cascade CSTR	
13. Kinetics of photochemical reaction	
14. Demonstration of heterogeneous catalytic reaction	
15. Demonstration of gas-liquid reaction	
16. Kinetics study in Adiabatic reactor	
17. Determination of Activation Energy of a reaction	
18. Kinetic study in semi batch reactor	
Total No of Periods to be Taught	45

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Determine the rate constant experimentally in a batch reactor.

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CO2:	Determine the conversion of a reaction in different reactors (batch, CSTR, PFR)
CO3:	Study of temperature dependence of rate constant.
CO4:	Determine the non-ideal behaviour and residence time distribution in PFR and CSTR.
CO5:	Determine the conversion of reactor arranged in series and the rate constant using sono and photo chemical reactors.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Batch reactor	1
2	Plug flow reactor	1
3	Continuous Stirred Tank Reactor	1
4	Sono chemical reactor	1
5	Photo chemical reactor	1
6	Packed bed reactor	1
7	Adiabatic Reactor	1
8	Cascade CSTR	1
9	Semi batch reactor	1
10	PFR followed by CSTR	1

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	2	3	2	2	3	3	-
CO2	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO3	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO4	3	3	3	2	2	1	1	2	3	2	2	3	3	-
CO5	3	3	3	3	2	1	1	2	3	2	2	3	3	-
Avg.	3	3	3	3	2	1	1	2	3	2	3	3	3	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24702	PROCESS EQUIPMENT DESIGN AND DRAWING	L	T	P	C	100
		0	0	3	1.5	
Course Objectives	Students learn to do in detail process and mechanical design and engineering drawing of different chemical engineering equipments					

UNIT – I	
Heat Exchangers, Condensers, Evaporators	
UNIT – II	
Cooling Tower, Dryers	
UNIT – III	
Absorption column, Distillation Column, Extraction Column, Adsorption column	
UNIT – IV	
Packed bed Reactors, Pressure Vessel, Storage Vessel	
UNIT – V	
Design of Plant Layout, Pipe Lines and Pipe Layouts, Schematics and Presentation Materials of Construction and Selection of process equipments	
Total No of Periods to be Taught	30

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Design double pipe and shell and tube heat exchangers according to standards such as BIS, TEMA
CO2:	Design Cooling towers and evaporators and design evaporators and crystallizer
CO3:	Process and Equipment Design of separation equipments such as absorbers, distillation column, extractors
CO4:	Calculate the design specifications of packed bed reactor and storage vessels, bins and silos

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CO5:	Determine sizes, materials, and capital and operating costs of equipment commonly used in the chemical processing industries and the essential elements of a chemical engineering process (equipment sizes, material & energy balances, economics, environmental, safety)
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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO.	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Drawing Table	30

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	-	2	2	2	2	3	3	2
CO2	3	3	3	2	3	3	-	-	-	2	2	3	3	-
CO3	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO4	3	3	3	2	2	-	-	-	-	2	2	3	3	-
CO5	3	3	3	2	3	3	-	2	2	2	2	3	3	2
Avg.	3	3	3	2	3	3	-	2	2	2	2	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCSI24701	SUMMER INTERNSHIP	L	T	P	C	100
		0	0	0	1	
Course Objectives	- Get connected with industry/ laboratory/research institute - Get practical knowledge on production process in the industry and develop skills to solve related problems - Develop skills to carry out research in the research institutes/laboratories					

List of Exercises/Experiments

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

Total No of Periods to be Taught	2 WEEKS
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COURSE OUTCOMES:

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

CO1:	Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2:	Analysis of industrial / research problems and their solutions
CO3:	Documenting of material specifications, machine and process parameters, testing parameters and results
CO4:	Preparing of Technical report and presentation


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Semester VIII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHL24801	PROJECT WORK / INTERNSHIP	L	T	P	C	100
		0	0	20	10	
Course Objectives	- Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college. - Conducting experiments, analyze and discuss the test results, and make conclusions. - Preparing project reports and presentation					

List of Exercises/Experiments

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

Total No of Periods to be Taught	300 PERIODS
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COURSE OUTCOMES:

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

CO1:	Formulate and analyze problem / create a new product/ process.
CO2:	Design and conduct experiments to find solution
CO3:	Analyze the results and provide solution for the identified problem, prepare project report and make presentation.



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Department	MBA	Programme Code & Name	COMMON TO ALL
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGET24701	PRINCIPLES OF MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Sketch the Evolution of Management. • Extract the functions and principles of management. • Learn the application of the principles in an organization. • Study the various HR related activities. • Analyze the position of self and company goals towards business.					

Unit-I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	(9)
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	PLANNING	(9)
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	ORGANISING	(9)
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	DIRECTING	(9)
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	CONTROLLING	(9)
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 No of Periods to be Taught		45 periods

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TEXT BOOK:

- 1 Harold Koontz and Heinz Weihrich “ Essentials of management ”TataMcGrawHill, 1998.
- 2 Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall(India)Pvt.Ltd., 10th Edition, 2009.

REFERENCES:

- 1 Robert Kreitner and Mamata Mohapatra, “Management”, Biztantra, 2008.
- 2 Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
- 3 Tripathy P C and Reddy PN, “Principles of Management”, Tata McgrawHill, 1999.

COURSE OUTCOMES:

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

- | | |
|------|--|
| CO1: | Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling. |
| CO2: | Have same basic knowledge on international aspect of management. |
| CO3: | Ability to understand management concept of organizing. |
| CO4: | Ability to understand management concept of directing. |
| CO5: | Ability to understand management concept of controlling. |

Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	2	1	1
CO2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	1	-	-	2	1	-	1	-	2	-	1	1	-	-	2
CO4	-	1	1	1	1	-	-	1	2	-	-	-	1	1	1
CO5	1	-	-	-	1	1	-	-	-	3	-	1	1	-	1
Avg.	1. 6	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy

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Department	MBA	Programme Code & Name	COMMON TO ALL
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGET24702	TOTAL QUALITY MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. - Explain the TQM Principles for application. Describe Taguchi's Quality Loss Function, performance measures and apply Techniques like QFD, TPM, COQ and BPR. - Illustrate and apply QMS and EMS in any organization. - Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.					

Unit-I	INTRODUCTION	(9)
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM(Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.		
Unit-II	TQM PRINCIPLES	(9)
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement –Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.		
Unit-III	TQM TOOLS & TECHNIQUES I	(9)
The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
Unit-IV	TQM TOOLS & TECHNIQUES II	(9)
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.		
Unit-V	QUALITY MANAGEMENT SYSTEM	(9)
Introduction-BenefitsofISORegistration-ISO9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards— Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		

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Total No of Periods to be Taught	45 periods
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TEXT BOOK:	
1	Dale H. Besterfield, Carol B.Michna, Glen H.Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:	
1	Joel.E.Ross, "Total Quality Management-Text and Cases", Routledge, 2017.
2	Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth-Heinemann Ltd, 2016.
3	Oakland, J.S. "TQM-Text with Cases", Butterworth-Heinemann Ltd., Oxford, Third Edition, 2003.
4	Suganthi, Land An and Samuel, "Total Quality Management", Prentice Hall (India) Pvt.Ltd., 2006.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Ability to apply TQM concepts in a selected enterprise.
CO2:	Ability to apply TQM principles in a selected enterprise.
CO3:	Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4:	Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM
CO5:	Ability to apply QMS and EMS in any organization.

Mapping of COs with POs and PSOs															
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO 11	PO1 2	PSO 1	PSO 2	PSO3
CO1	-	3	-	-	-	-	-	-	-	-	-	3	2	-	3
CO2	-	-	-	-	-	3	-	-	-	-	-	3	-	2	
CO3	-	-	-	-	3	-	-	-	3	-	-		-	2	3
CO4	-	2	-	-	3	2	3	2	-	-	-	3	3	2	
CO5			3			3	3	2							
Avg.	-	3	-	-	-	-	-	-	-	-	-	3	2	-	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy															

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Department	MBA	Programme Code & Name				COMMON TO ALL	
Semester							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UGET24703	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C	100	
		3	0	0	3		
Course Objectives	- Understanding the concept of Engineering Economics. - Implement various micro economics concept in real life. - Gaining knowledge in the field of macro economics to enable the students to have better understanding of various components of macroeconomics. - Understanding the different procedures of pricing. - Learn the various cost related concepts in microeconomics.						
Unit-I	DEMAND&SUPPLY ANALYSIS						(9)
Managerial Economics-Relationship with other disciplines-Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand – Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply – Determinants of supply - Supply function -Supply elasticity.							
Unit-II	PRODUCTIONANDCOST ANALYSIS						(9)
Production function>Returns to scale - Production optimization-Least cost input- Isoquants – Managerial uses of production function. Cost Concepts-Cost function-Determinants of cost-Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.							
Unit-III	PRICING						(9)
DeterminantsofPrice-Pricingunderdifferentobjectivesanddifferentmarketstructures – Price discrimination-Pricing methods in practice.							
Unit-IV	FINANCIALACCOUNTING(ELEMENTARYTREATMENT)						(9)
Balance sheet and related concepts- Profit & Loss Statement and related concepts—Financial Ratio Analysis-Cash flow analysis-Funds flow analysis- Comparative financial statements-Analysis & Interpretation official statements.							
Unit-V	CAPITALBUDGETING(ELEMENTARYTREATMENT)						(9)
Investments- Risks and return evaluation of investment decision- Average rate of return- Payback Period- Net Present Value- Internal rate of return.							
Total No of Periods to be Taught				45 periods			

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TEXT BOOK:

1	Paneer Selvam, R, “ Engineering Economics ”,Prentice Hall of India Ltd,NewDelhi,2001.
2	Managerial Economics: Analysis, Problems and Cases- P.L.Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCES:

1	Chan S.Park, “ Contemporary Engineering Economics ”, Prentice Hall of India, 2011.
2	Donald. G.Newman, Jerome. P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3	Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4	Zahid Akhan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5	Dr. S.N.Maheswari and Dr. S.K.Maheshwari: Financial Accounting, Vikas, 2009

COURSE OUTCOMES:

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

CO1:	Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions
CO2:	Evaluate the economic theories, cost concepts and pricing policies
CO3:	Understand the market structures and integration concepts
CO4:	Understand the measures of national income, the functions of banks and concepts of globalization
CO5:	Apply the concepts official management for project appraisal

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	2	-	-	1	3
CO2	-	3	-	-	-	-	-	-	-	-	-	-		2
CO3	-	2	-	-	-	-	-	-	-	-	-	-		0
CO4	2	3	3	-	2	-	-	-	-	-	-	-	2	3
CO5	3	3	3	-	2	-	-	-	-	-	-	-	2	0

1 – Slight, 2 – Moderate, 3 –Substantial, BT – Bloom’s Taxonomy

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Department	MBA	Programme Code & Name			COMMON TO ALL	
Semester						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGET24704	HUMAN RESOURCE MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To provide knowledge about management issues related to staffing, - To provide knowledge about management issues related to training, - To provide knowledge about management issues related to performance - To provide knowledge about management issues related to compensation - To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.					
Unit-I	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT					(9)
The importance of human resources– Objective of Human Resource Management-Human resource policies - Role of human resource manager.						
Unit-II	HUMAN RESOURCE PLANNING					(9)
Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.						
Unit-III	TRAININGAND EXECUTIVE DEVELOPMENT					(9)
Types of training and Executive development methods–purpose–benefits.						
Unit-IV	EMPLOYEE COMPENSATION					(9)
Compensationplan–Reward–Motivation–CareerDevelopment-Mentor–Protege relationships.						
Unit-V	PERFORMANCE EVALUATION AND CONTROL					(9)
Performance evaluation – Feedback - The control process – Importance –Methods – grievances – Causes – Redressal methods.						
Total No of Periods to be Taught				45 periods		

TEXT BOOK:	
1	Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2	John Bernardin. H., "Human Resource Management–An Experimental Approach", 5 th Edition, Tata McGraw Hill, 2013, New Delhi.

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REFERENCES:

1	Luis R., Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, "ManagingHumanResources", 7 th Edition, PHI, 2012.
2	Dessler, "Human Resource Management", Pearson Education Limited, 2007.

COURSE OUTCOMES:

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

CO1:	Students would have gained knowledge on the various aspects of HRM
CO2:	Students will gain knowledge needed for success as a human resources professional.
CO3:	Students will develop the skills needed for a successful HR manager.
CO4:	Students would be prepared to implement the concepts learned in the workplace.
CO5:	Students would be aware of the emerging concepts in the field of HRM

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2	1	1	2	1	1	1	1	1
CO2	3	3	2	3	2	2	2	2	3	1	2	1	1	2
CO3	3	3	3	3	3	3	2	2	3	1	2	1	1	2
CO4	3	3	2	3	3	2	2	2	2	1	1	1	1	1
CO5	3	3	1	2	2	2	2	2	2	1	1	1	1	1
Avg.	2.8	2.8	1.8	2.6	2.6	2.2	1.8	1.8	2.4	1	1.4	1	1	1.4

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MBA	Programme Code & Name				COMMON TO ALL	
Semester							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UGET24705	KNOWLEDGE MANAGEMENT		L	T	P	C	100
Course Objectives	The student should be made to: - Learn the Evolution of Knowledge management. - Be familiar with tools. - Be exposed to Applications. - Be familiar with some case studies.						
Unit-I	INTRODUCTION						(9)
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.							
Unit-II	CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING						(9)
Organization and Knowledge Management –Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists–Tacit Knowledge and Quality Assurance.							
Unit-III	KNOWLEDGE MANAGEMENT – THE TOOLS						(9)
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.							
Unit-IV	KNOWLEDGE MANAGEMENT APPLICATION						(9)
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI							
Unit-V	RESPIRATORY DISEASES						(9)
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life cycles of an organization.							
Total No of Periods to be Taught				45 periods			

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TEXT BOOK:

1	Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.
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REFERENCES:

1	Nonaka, I., Takeuchi, H., "The Knowledge – Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.
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COURSE OUTCOMES:

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

CO1:	Understand the process of acquiring knowledge from experts
CO2:	Understand the learning organization.
CO3:	Use the knowledge management tools.
CO4:	Develop knowledge management Applications.
CO5:	Design and develop enterprise applications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					1									
CO2					2								1	
CO3					2									2
CO4				1	1				1					1
CO5				1	1				1					1
Avg.				1	1.4				1				1	1.3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MBA	Programme Code & Name	COMMON TO ALL
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UGET24706	INDUSTRIAL MANAGEMENT	L	T	P	C	100
		3	0	0	3	

Course Objectives	- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations. - To study the planning; organizing and staffing functions of management in professional organization. - To study the leading; controlling and decision-making functions of management in professional organization. - To learn the organizational theory in professional organization. - To learn the principles of productivity and modern concepts in management in professional organization.
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Unit-I	INTRODUCTION TO MANAGEMENT	(9)
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Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

Unit-II	FUNCTIONS OF MANAGEMENT - II	(9)
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Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake – Mount on, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

Unit-III	FUNCTIONS OF MANAGEMENT - II	(9)
-----------------	-------------------------------------	------------

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake – Mount on, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

Unit-IV	ORGANIZATION THEORY	(9)
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Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

Unit-V	PRODUCTIVITY AND MODERN TOPICS	(9)
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Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Bench

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marking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems(MIS).

Total No of Periods to be Taught

45 periods

TEXT BOOK:

- | | |
|---|---|
| 1 | M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009. |
| 2 | Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8 th Edition, Tata McGrawhill, New Delhi, 2010. |

REFERENCES:

- | | |
|---|---|
| 1 | JosephJ, Massie, "Essentials of Management", 4 th Edition, Pearson Education, 1987. |
| 2 | Saxena, P.K., "Principles of Management: A Modern Approach", Global India Publications, 2009. |
| 3 | S. Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994. |
| 4 | RichardL. Daft, "Organization Theory and Design", South Western College Publishing, 11 th Edition, 2012. |
| 5 | S.Trevis Certo, "Modern Management Concepts and Skills", Pearson Education, 2018. |

COURSE OUTCOMES:

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

- | | |
|------|---|
| CO1: | Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations. |
| CO2: | Discuss the planning; organizing and staffing functions of management in professional organization. |
| CO3: | Apply the leading; controlling and decision-making functions of management in professional organization. |
| CO4: | Discuss the organizational theory in professional organization. |
| CO5: | Apply principles of productivity and modern concepts in management in professional organization. |

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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO2	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO3	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO4	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO5	1	1	1	1	1	3	2	3	2	3	1	3	1	1
Avg.	1	1	1	1	1	3	2	3	2	3	1	3	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24001	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C	100
		2	0	0	0	
Course Objectives	✓ To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management ✓ To acquaint with the skills for planning and organizing disaster response					

Unit-I	HAZARDS, VULNERABILITY AND DISASTER RISKS	(9)
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies- Inter relations between Disasters and Sustainable development Goals		
Unit-II	DISASTER RISK REDUCTION (DRR)	(9)
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.		
Unit-III	DISASTER MANAGEMENT	(9)
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)		
Unit-IV	TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT	(9)
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management		
Unit-V	DISASTER MANAGEMENT: CASE STUDIES	(9)


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Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

Total No of Periods to be Taught

Total : 30 Periods

TEXT BOOK:

1	Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2	Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
4	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES:

1	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2	Government of India, National Disaster Management Policy, 2009.
3	Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOMES:

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

CO1:	To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction
CO2:	To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3:	To develop disaster response skills by adopting relevant tools and technology
CO4:	Enhance awareness of institutional processes for Disaster response in the country
CO5:	Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity


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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	2	2	-	-	2	-	2	-
CO2	3	3	3	3	-	-	2	1	-	-	2	-	2	-
CO3	3	3	3	3	-	-	2	2	-	-	-	-	2	-
CO4	3	3	2	3	-	-	2	1	-	-	2	-	2	-
CO5	3	3	2	3	-	-	2	2	-	-	2	-	3	-
Avg.	3	3	3	3	-	-	2	2	-	-	2	-	2	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24002	ELEMENTS OF LITERATURE	L	T	P	C	100
		2	0	0	0	
Course Objectives	To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience					

COURSE CONTENTS

	Introduction to Elements of Literature	(5)
1.Relevance of literature		
a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.		
2. Elements of fiction		(5)
a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.		
3. Elements of poetry		(5)
a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony) d) Personification and animation e) Rhetoric and trend.		
4.Elements of drama		(5)
a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.		
READINGS:		(5)
a) An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007. b) An Introduction to Literary Studies, Mario Klarer, Routledge, 2013. c) The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press, 1991. d) The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114. e) The Elements of Drama, J.L.Styan, Literary Licensing, 2011.		

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OTHER SESSION:		(5)
	4.1 *Tutorials: 4.2 *Laboratory: 4.3 *Project: The students will write a term paper to show their understanding of a particular piece of literature	
4*ASSESSMENT:		
	5.1 HA: 5.2 Quizzes-HA: 5.3 Periodical Examination: one 5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc. 5.5 Final Exam:	
	Total No of Periods to be Taught	Total: 30 periods

TEXT BOOK:	
1	3.1 Textbook: 3.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1	Recognize the relevance of literature in enhancing life skills and human understanding.
CO2	Identify and describe key elements of fiction, poetry, and drama.
CO3	Analyze the use of figurative language and rhetorical devices in poetry and prose.
CO4	Interpret and evaluate dramatic forms based on structure and performance.
CO5	Compose a term paper demonstrating critical understanding of a chosen literary work.


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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	2	2	3	2	-	-	-	-	-	-	-	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24003	FILM APPRECIATION	L	T	P	C	100
		2	0	0	0	
Course Objectives	In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.					

Unit-I	THE COMPONENT OF FILMS	(6)
The material and equipment, The story, screenplay and script, The actors, crew members, and the director, The process of film making, Structure of a film		
Unit-II	EVOLUTION OF FILM LANGUAGE	(6)
Film language, form, movement etc, Early cinema, Silent film (Particularly French), The emergence of feature films: Birth of a Nation, Talkies		
Unit-III	FILM THEORIES AND CRITICISM/APPRECIATION	(6)
Realist theory: Auteurists, Psychoanalytic, Ideological, Feminists, How to read films? Film Criticism / Appreciation		
Unit-IV	DEVELOPMENT OF FILM	(6)
Representative Soviet films, Representative Japanese films, Representative Italian films, Representative Hollywood film and the studio system.		
Unit-V	INDIAN FILMS	(6)
The early era, The important films made by the directors, The regional films, The documentaries in India		
READING: A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.		
Total No of Periods to be Taught		Total: 30 Periods


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COURSE OUTCOMES:

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

CO1:	Gain a comprehensive understanding of filmmaking components and techniques
CO2:	Explore the historical evolution of film language and major milestones.
CO3:	Develop critical analysis skills through the study of various film theories.
CO4:	Broaden cultural awareness by analyzing representative films from diverse contexts.
CO5:	Appreciate the development and diversity of Indian cinema

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24004	INTRODUCTION TO GENDER STUDIES	L	T	P	C	100
		2	0	0	0	
Course Objectives	✓ To introduce foundational concepts such as sex, gender, patriarchy, socialization, power, and stereotypes to understand gendered structures in society. ✓ To explore major feminist theories (Liberal, Marxist, Socialist, Radical, Psychoanalytic, Postmodernist, Ecofeminist) and their approaches to gender. ✓ To provide a historical and socio-political understanding of global and local women's movements and their impact on gender discourse. ✓ To examine how language constructs and reflects gender identities and power relations through narratives and linguistic forms. ✓ To analyze the representation of gender in mainstream, alternative, and social media, with emphasis on stereotypes and visual culture.					

Unit-I	CONCEPTS	(6)
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.		
Unit-II	FEMINIST THEORY	(6)
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.		
Unit-III	WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL	(6)
Rise of Feminism in Europe and America. Women's Movement in India.		
Unit-IV	GENDER AND LANGUAGE	(6)
Linguistic Forms and Gender. Gender and narratives		
Unit-V	GENDER AND REPRESENTATION	(6)
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.		
Total No of Periods to be Taught		Total: 30 periods


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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	2	2	3	2	-	-	-	-	-	-	-	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24005	INDUSTRIAL SAFETY	L	T	P	C	100
Course Objectives	The course is intended to give knowledge of various safety management principles, various safety systems, various machine guarding devices, hazard identification techniques, energy sources, systems & applications and the need in the present context.					

Unit-I	SAFETY INTRODUCTION	(6)
Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. 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-need, types, advantages.		
Unit-II	PERSONAL PROTECTION IN WORK ENVIRONMENT	(6)
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.		
Unit-III	SAFETY ISSUES IN CONSTRUCTION	(6)
Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures.		
Unit-IV	SAFETY HAZARDS IN MACHINES	(8)
Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.		
Unit-V	HAZARD IDENTIFICATION AND ANALYSIS	(4)
Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment.		
Total No of Periods to be Taught		30 periods
TEXT BOOK:		

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1	R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2	Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication

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

COURSE OUTCOMES:

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

CO1:	Describe the theories of accident causation and preventive measures of industrial accidents.
CO2:	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping
CO3:	Explain different issues in construction industries.
CO4:	Describe various hazards associated with different machines and mechanical material handling.
CO5:	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	-	1	2	2	2	-	-	-	1	-	-
CO2	2	2	2	-	1	1	1	1	-	-	-	1	-	-
CO3	2	2	2	-	1	1	1	1	1	1	-	1	-	-
CO4	2	2	2		1	1	1	1	1	1	-	1	-	-
CO5	2	2	2	-	1	1	1	1	1	1	-	1	-	-
Avg.	2	2	1.6	-	1	1.2	1.2	1.2	0.6	0.6	-	1	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24006	INTERPERSONAL SKILLS	L	T	P	C	100
		2	0	0	0	
Course Objectives	✓ Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills. ✓ Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities. ✓ improve general and academic listening skills ✓ Make effective presentations.					

Unit-I	(6)
Listening as a key skill- its importance- speaking- give personal information- ask for personal information- express ability- enquire about ability- ask for clarification Improving pronunciation pronunciation basics taking lecture notes- preparing to listen to a lecture- articulate a complete idea as opposed to producing fragmented utterances	
Unit-II	(6)
Listen to a process information- give information, as part of a simple explanation- conversation starters: small talk- stressing syllables and speaking clearly- intonation patterns- compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.	
Unit-III	(6)
Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk- greet- respond to greetings- describe health and symptoms- invite and offer- accept- decline- take leave- listen for and follow the gist- listen for detail	
Unit-IV	(6)
Being an active listener: giving verbal and non-verbal feedback- participating in a group discussion summarizing academic readings and lectures conversational speech listening to and participating in conversations- persuade	
Unit-V	(6)
Formal and informal talk- listen to follow and respond to explanations, directions and instructions in academic and business contexts- strategies for presentations and interactive communication group/pair presentations- negotiate disagreement in group work.	
Total No of Periods to be Taught	Total: 30 periods

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TEXT BOOK:

1	Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2	Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:

1	Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2	Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3	Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
4	Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5	Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013

COURSE OUTCOMES:

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

CO1:	Demonstrate effective listening and speaking strategies to express and gather personal information clearly.
CO2:	Interpret process-based information and participate in informal conversation with correct pronunciation and intonation.
CO3:	Use lexical chunks and phrases to improve fluency and accuracy in short speeches and daily interactions.
CO4:	Apply active listening strategies and participate effectively in group discussions and academic contexts.
CO5:	Engage in formal/informal talk and deliver structured presentations in academic and professional environments.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	-	-	-	-	-	-	-	3	3
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	3
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
Avg.	3	2.6	3	2.2	2.6	-	-	-	-	-	-	-	3	3

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24007	PERSONALITY AND CHARACTER DEVELOPMENT	L	T	P	C	100
		2	0	0	0	
Course Objectives	To understand the dimensions of personality, theories of Freud and Erickson, and the importance of personality growth.					
	To develop positive attitudes and motivation through awareness of influencing factors and self-drive.					
	To build self-esteem and interpersonal effectiveness through self-awareness and behavior understanding.					
	To enhance problem-solving, leadership, and time management skills for overall personality refinement.					
	To improve employability skills like resume writing, group discussion, and interviews through practical engagement.					

Unit-I	INTRODUCTION TO PERSONALITY DEVELOPMENT	6
The concept of personality - Dimensions of personality – Theories of Freud & Erickson-Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis.		
Unit-II	ATTITUDE & MOTIVATION	6
Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation		
Unit-III	SELF-ESTEEM	6
Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low self esteem - Positive and negative self esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking.		
Unit-IV	OTHER ASPECTS OF PERSONALITY DEVELOPMENT	6
Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management Work ethics – Good manners and etiquette.		
Unit-V	EMPLOYABILITY QUOTIENT	6


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Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions

Total No of Periods to be Taught

Total: 30 periods

TEXT BOOK:

1	Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
2	Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behavior 16th Edition: Prentice Hall.

REFERENCES:

1	Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw-Hill 1988.
2	Heller, Robert.Effective leadership. Essential Manager series. Dk Publishing, 2002
3	Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003
4	Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
5	Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6	Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.
7	Smith, B . Body Language. Delhi: Rohan Book Company. 2004

COURSE OUTCOMES:

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

CO1:	Explain the concept and dimensions of personality and analyze theories of Freud and Erickson
CO2:	Identify the role of attitude and motivation in personal success and apply strategies to stay self-motivated
CO3:	Recognize types of self-esteem and behaviors; develop assertiveness and interpersonal relationship skills
CO4:	Demonstrate skills in body language, leadership, stress management, and decision-making for personality growth
CO5:	Apply practical techniques for enhancing employability including resume writing, interviews, and group discussion techniques


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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	-	-	-	-	-	2	2
CO2	3	3	3	3	2	2	3	-	-	-	-	-	3	3
CO3	2	2	3	3	2	2	3	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	3	-	-	-	-	-	3	3
CO5	2	2	3	2	3	3	3	-	-	-	-	-	3	3
Avg.	2.6	2.6	2.8	2.6	2.4	2.4	2.8	-	-	-	-	-	2.8	2.8

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMC24008	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C	100
		2	0	0	0	
Course Objectives	To enjoy life happily with fun filled new style activities that help to maintain health also					
	To adapt a few lifestyle changes that will prevent many health disorders					
	To be cool and handbill every emotion very smoothly in every walk of life					
	To learn to eat cost effective but healthy foods that are rich in essential nutrients					
	To develop immunity naturally that will improve resistance against many health disorders					

Unit-I	HEALTH AND ITS IMPORTANCE	(6)
Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health. Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease - cancer - diabetes - chronic pulmonary diseases - risk factors - tobacco - alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders - Obesity - Diabetes - Cardiovascular diseases - Cancer - Strokes - COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken		
Unit-II	DIET	(6)
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes - arthritis - hypertension - PCOD - infertility - ADHD - sleeplessness - helps to reduce the risk of heart diseases - keeps the teeth and bones strong. Balanced Diet and its 7 Components - Carbohydrates - Proteins - Fats - Vitamins - Minerals - Fibre and Water. Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM Common cooking mistakes Different cooking methods, merits and demerits of each method		
Unit-III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	(6)


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AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene
- Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri- Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

Unit-IV	MENTAL WELLNESS	(6)
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Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life - Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. **Stress management** - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

Unit-V	YOGA	(6)
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Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

Total No of Periods to be Taught	Total: 30 periods
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TEXT BOOK:

1	Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2	Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body,

REFERENCES:

1	WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
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2	The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
3	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
4	Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20c ook.
5	Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
6	https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
7	Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html
8	Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives
9	BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/ https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
10	Yoga https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/ Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
11	Siddha : http://www.tkdL.res.in/tkdL/langdefault/Siddha/Sid_Siddha_Concepts.asp
12	CAM : https://www.hindawi.com/journals/ecam/2013/376327/
13	Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:

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

CO1:	Learn the importance of different components of health
CO2:	Gain confidence to lead a healthy life
CO3:	Learn new techniques to prevent lifestyle health disorders

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	-	-	-	-	-	-	-	3	2
CO2	2	2	2	3	3	-	-	-	-	-	-	-	2	3
CO3	3	3	1	3	3	-	-	-	-	-	-	-	2	3
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	2.7	2.3	1.3	3.0	2.7	2.3	2.7	2.3	2.7	2.3	1.3	3.0	2.7	2.3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2401	PETROLEUM CHEMISTRY AND REFINING FUNDAMENTALS	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to learn the fundamental and methodologies in the petroleum refining processes •To enable students to examine how each refinery process works •To enable students to express the objectives of petroleum refining and classify the processes used in petroleum refining •To enable students learn how physical and chemical principles are applied to achieve the objectives of each refinery process					

Unit-I	CRUDE CHEMISTRY AND PRODUCTS	(9)
Origin, Formation and Evaluation of Crude Oil -Indian petroleum industries- types of Hydrocarbon - composition of crude oil (PONA,S,N ₂ etc) -Thermo-physical and physical properties of crude oil-petroleum standards- chemical analysis data- Testing methods of petroleum products-Chemical quality of products-Types of crude-Crude assay- selection of crude based on product yield.		
Unit-II	BASICS FOR REFINING	(9)
Properties of gas-Ideal gas laws-partial pressure-specific gravity-density-Properties of liquid-viscosity and index-boiling point-pressure of fluid at rest-flow resistance-static/induced pressure-specific/latent heat/condensation-modes of heat transfer-diffusion mass transfer-properties of solid.		
Unit-III	PETROLEUM THERMODYNAMICS AND CALCULATION	(9)
First/second law-behavior of gas and liquid – PVT relationship- equation of state-VLE- equilibrium constant-Multi component liquid vapor composition calculation-specific gravity calculation-TBP distillation-ASTM-conversion to pseudo-components-Molecular weight calculation-pseudo-critical properties-calculation of enthalpy of petroleum fractions-Generalized equation for thermo physical properties of petroleum.		
Unit-IV	REFINERY UNIT OPERATIONSAND CALCULATION	(9)
Distillation-types-column internals-multi component distillation-relative volatility- azeotropic mixture-absorption- desorption- adsorption- refrigeration - extraction- drying curve-humidification principle-crystallization-stripping operation-.boiling curve- application of all operation in refinery and its basic design calculations.		
Unit-V	REFINERY PROCESSES AND CATALYST FUNDAMENTAL	(9)

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Treating processes of petroleum products- Thermal/catalytic/hydro cracking-reforming/ isomerization /alkylation -principles and reactions- Catalyst phenomenon and theory- surface area/void volume/porosity- catalyst classification and preparation/selectivity/yield/reactivity-heterogeneous reactions- catalytic reactor types (packed bed/moving bed/fluidized bed)- residence time-space velocity- Catalyst loading techniques.

Total No of Periods to be Taught

45

TEXT BOOK:

1	Fundamentals of Petroleum Refining, M.A. Fahim, T.A. Al-sahhaf, A.S. Elkilani; Elsevier Science and Technology.
2	Modern Petroleum Refining Processes, BK Bhaskara Rao, Oxford & IBH Publishing Co. Pvt. Ltd.
3	The Chemistry and technology of Petroleum, James G. Speight, CRC Press, Taylor & Francis Group.
4	Prasad, R., "Petroleum Refining Technology", Khanna Publishers, New Delhi, 2000
5	Jean vidal, Thermodynamics Application in chemical Engineering and the petroleum industry, Institute Francais bu petrol epublications, France 2003
6	McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7 th Edition, McGraw-Hill, 2005.
7	Treybal, R.E., "Mass Transfer Operations", 3 rd Edn., McGraw-Hill, 1981.

REFERENCES:

1	W. L. Nelson, Petroleum Refinery Engineering,, McGraw-Hill Book Co , 1969
2	J. H. Gary, H. Hanwerk and M. J. Kaiser, Petroleum Refining Technology and Economics, CRC Press , 5th Edition, 2007
3	Wayne C. Edmister, "Applied Hydrocarbon Thermodynamics", Gulf Publishing Co., 2 nd edition, 1988
4	R.N. Watkin, "Petroleum Refinery Distillation", Gulf Publishing Co, Houston, Texas, USA, 2nd edition, 1981
5	Handbook of Petroleum Analysis, James G. Speight, Wiley-Interscience, John Wiley & Sons, Inc., Publications
6	Holland, C. D. (1963). Multicomponent distillation. Prentice-Hall.

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COURSE OUTCOMES:

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

CO1:	Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.
CO2:	Understand the insights of primary treatment processes to produce the precursors.
CO3:	Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.
CO4:	Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.
CO5:	Understand the societal impact of petrochemicals and learn their manufacturing processes and Learn the importance of optimization of process parameters for the high yield of petroleum products.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	2	1	-	1	1	1	1	1	1	2	2	1
CO2	2	1	1	1	2	1	1	1	1	1	2	2	2	1
CO3	1	1	2	1	2	1	-	1	1	1	1	1	2	1
CO4	1	2	2	2	1	2	2	2	2	1	2	1	2	2
CO5	1	2	2	1	1	1	1	2	2	-	1	1	2	1
Avg.	1	1	2	1	1	1	1	1	1	1	1	1	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2402	PRIMARY REFINING TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to learn the methodologies in the primary petroleum refining processes like crude preparation, atmospheric and vacuum distillation, Lube, asphalt and wax processing •To enable students to examine how each refinery process works •To enable students learn each operating variables are applied to achieve the objectives of each refinery process					

Unit-I	FEED PREPARATION	(9)
Pipelines from port to tank farm -safety and regulations -storage techniques in crude oil-impurities removal- measuring by dipping -spiking techniques -types of salts in crude - desalting process – electric desalter- preheating train and design- furnace and its operation.		
Unit-II	ATMOSPHERIC DISTILLATION	(9)
Operation and process description of ADU-design characteristics of ADU tower-cutpoints-degree of fractionation-over flash-column pressure and overhead temperature- Preflash system-overhead system-side streams-intermediate pump around and reflux systems- Refinery off gas – LPG treatment-Naphtha stabilizer and splitter-side stripping sections-operating variables.		
Unit-III	VACUUM DISTILLATION	(9)
Operation of VDU- Need of vacuum- ejectors and its types/principle- Overhead ejector system-flash zone- draw off temperature- internal flow in VDU- light/middle/heavy cuts- routing to secondary units-lube based treatments-packing section tower loading of VDU.		
Unit-IV	LUBE OIL BASE STOCKS	(9)
Viscosity index calculation and pour point - LOBS processing by solvent treatment and hydro treatment-solvent selection-solvent extraction by NMP, furfural,- MEK solvent dewaxing/- refrigerating and filtration -hydro finishing- types of LOBS based on VI- types or groups of lube processing-spindle/LN/IN/HN/BN processing and blending.		
Unit-V	ASPHALT AND WAX TECHNOLOGY	(9)
Vacuum residue properties- propane deasphalting-asphalt processing and types-chemical structure-air blowing of bitumen- slack wax processing- wax and types/properties- wax deoiling-unit operations in wax plants- refrigerating and filtration/ hydro treating of wax-molding and storage.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Modern Petroleum Refining Processes, BK BhaskaraRao, Oxford & IBH Publishing Co. Pvt. Ltd.
2	Prasad, R., "Petroleum Refining Technology", Khanna Publishers, New Delhi, 2000
3	W. L. Nelson, Petroleum Refinery Engineering,, McGraw-Hill Book Co , 1969
4	J. H. Gary, H. Hanwerk and M. J. Kaiser, Petroleum Refining Technology and Economics, CRC Press , 5th Edition, 2007
5	Fundamentals of Petroleum Refining, M.A. Fahim, T.A. Al-sahhaf, A.S. Elkilani; Elsevier Science and Technology

REFERENCES:

1	J.G. Speight and B. Ozum, "Petroleum Refining Processes", Marcel Dekker Inc, New York, 2002
2	G.D. Hobson, "Modern Petroleum Technology", Vol I & II, John Wiley & Sons, New York, 5th edition, 1984
3	David.S.J."STAN" Jones and Peter R.Pujado "Handbook of Petroleum Processing, Springer, 2006
4	Smalheer, C.V and R. Kennedy Smith Lubricant Additives. The Lezius – Hill Company, Cleveland, Ohio. USA, 1987

COURSE OUTCOMES:

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

CO1:	Understand the methodologies in the primary petroleum refining processes like crude preparation, atmospheric and vacuum distillation, Lube, asphalt and wax processing.
CO2:	Understand how each refinery process works
CO3:	Learn the operating variables which are applied to achieve the objectives of each refinery process
CO4:	Understand the methodologies of processing and blending
CO5:	Apply the concepts in asphalt processing and wax treatment technology

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	2	2	2	1	-	1	1	1	2
CO2	2	1	2	1	2	2	1	2	1	1	1	1	1	1
CO3	2	1	2	1	2	2	1	2	1	1	1	2	2	2
CO4	2	1	2	2	2	2	1	2	1	1	1	1	-	-

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CO5	2	1	2	2	2	2	1	2	1	1	1	2	1	1
Avg.	2	1	2	1	2	2	1	2	1	1	1	1	1	1
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy														

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2403	SECONDARY REFINING TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to learn the methodologies in the secondary petroleum refining or upgrading processes like thermal cracking, coking, catalytic cracking, hydrocracking ,hydro treating, reforming, isomerization, alkylation and sulfur finishing processes •To enable students to learn refinery operation on FCC, Vis breaker, DCU, Reformer, etc. and operation on utilities like steam, cooling water, instrument air, H ₂ , N ₂ etc. •To enable students learn each operating variables of all units					

Unit-I	THERMAL CRACKING AND COKING	(9)
Residue upgradation technologies- cracking-thermal cracking-mechanism/principle/reactions-process variables- Visbreaking- soaker process- coil visbreaker-Disadvantages-Coking-thermodynamics and mechanism of coking-delayed coking-operation-fluid coking-flexicoking-types of coke and properties-yield pattern of cracking and coking.		
Unit-II	CATALYTIC CRACKING	(9)
Principles of catalytic cracking-mechanisms- FCC- main reaction of FCC- role of FCC in refinery-Fluidization- feedstocks/products/yield pattern- Kinetics and thermodynamics of FCC reactions- FCC catalyst and licensor technologies- reaction/regeneration/fractionation sections-slide valves and its importance- riser/cyclone separator/reactor internals-RFCC/MSCC/Petro FCC.		
Unit-III	HYDROGEN AND HYDROCONVERSION	(9)
H ₂ requirements-steam reforming and shift conversion-operation and thermodynamics of reformer and NI catalyst-Hydro treatment processes- catalyst and reaction chemistry- Naphtha/Diesel/lube/wax/gasoline hydro treatment-Hydrocracking process- Typical hydrocracker in refinery-catalyst/severity/conversion/Temperature profile for yield pattern-reaction kinetics of hydrocracker-Operation and variables.		
Unit-IV	REFORMING/ISOMERISATION/ALKYLATION	(9)
Reforming feed index-RON-various reforming technologies-platforming reactions-kinetics and thermodynamics of Pt catalyst reactions-Operation in Straight Run and Continuous Run mode-yield calculation- Isomerization techniques- reactions and kinetics- various technologies in isomerization - importance of catalyst-hexane production-Alkylation process-reactions – various alkylation processes-process variables in reforming/isomerization/alkylation.		

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Unit-V	FINISHING PROCESSES AND UTILITIES	(9)
Sources of sulfur in refinery-types of sulfur compounds in crude-sweetening processes- various sulfur treatment process in products-H ₂ S properties and removal by physical and chemical process- Amine selection –amine absorption and regeneration-sour water stripping- Merox process- Sulfur recovery from H ₂ S by Claus /super Claus/ modified Claus technology/SCOT Process/CS ₂ process; Electricity and steam generation by Gas turbine/boiler-Cooling tower operation-Fuel oil-Cryogenic distillation of air to N ₂ and O ₂ production- Instrument air operation.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Modern Petroleum Refining Processes, B K Bhaskara Rao, Oxford & IBH Publishing Co. Pvt. Ltd.
2	Prasad, R., "Petroleum Refining Technology", Khanna Publishers, New Delhi, 2000
3	W. L. Nelson, Petroleum Refinery Engineering, McGraw-Hill Book Co , 1969
4	J. H. Gary, H. Hanwerk and M. J. Kaiser, Petroleum Refining Technology and Economics, CRC Press , 5th Edition, 2007
5	Fundamentals of Petroleum Refining, M.A. Fahim, T.A. Al-sahhaf, A.S. Elkilani; Elsevier Science and Technology

REFERENCES:

1	J.G. Speight and B. Ozum, "Petroleum Refining Processes", Marcel Dekker Inc, New York, 2002
2	G.D. Hobson, "Modern Petroleum Technology", Vol I & II, John Wiley & Sons, New York, 5th edition, 1984
3	David.S.J."STAN" Jones and Peter R. Pujado "Handbook of Petroleum Processing, Springer,2006
4	Smalheer, C.V and R. Kennedy Smith Lubricant Additives. The Lezius – Hill Company, Cleveland, Ohio. USA, 1987

COURSE OUTCOMES:

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

CO1:	Acquires knowledge on different methodologies in the secondary petroleum refining processes like thermal cracking, coking, catalytic cracking, hydrocracking.
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CO2:	Understand the operation on FCC, Vis breaker, DCU, Reformer.
CO3:	Helps to understand the operation on utilities like steam, cooling water, instrument air, H ₂ , N ₂ .
CO4:	Understand the basic knowledge on isomerisation, alkylation and reforming process.
CO5:	Gather some knowledge in the finishing processes and their operations in refining industries.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	2	2	1	2	1	1	2	1
CO2	1	2	1	2	2	2	1	1	2	2	2	1	1	1
CO3	2	1	1	2	2	2	2	2	2	2	1	1	2	2
CO4	1	2	1	1	2	1	2	1	2	2	1	1	1	2
CO5	1	1	1	1	2	2	1	2	1	1	2	1	1	2
Avg.	1	1	1	1	2	2	1	1	1	1	1	1	1	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2404	REFINERY ADVANCEMENTS AND ENVIRONMENTAL REGULATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to learn the methodologies in the secondary petroleum refining or upgrading processes like thermal cracking, coking, catalytic cracking, hydrocracking ,hydro treating, reforming, isomerization, alkylation and sulfur finishing processes •To enable students to learn refinery operation on FCC, Vis breaker, DCU, Reformer, etc. and operation on utilities like steam, cooling water, instrument air, H ₂ , N ₂ etc. •To enable students learn each operating variables of all units					

Unit-I	ENVIRONMENTAL REGULATION AND GOVERNMENT POLICIES	(9)
Classes of petroleum based on flash point- storage tank design- GAS/LIQUID/SOLID wastes form refinery units-environmental standards on air and water pollution and control-Solid waste management-Sludge conditioning and treatment and disposal- Effluent treatment plant-TTP-greenhouse gases-Bharat stages and its regulations- Recent modification for BS-6- Policies on biofuel-EBP-Bio-diesel.		
Unit-II	CORROSION AND SAFETY	(9)
Corrosion- reaction and types- refinery corrosion tests- controlling parameters- corrosion control in equipment and pipelines-Types of fire- Safety triangle- Firefighting equipment-PPE- HAZOP studies- Petroleum disasters case study- process safety protocol- pressure relief systems- flare systems- CBD/OWS- MSDS for units- oil spilling and skimming.		
Unit-III	ADVANCEMENTS IN REFINERY	(9)
Instrumentation- Flow/pressure/temperature/level transmitter-Control systems and logics – controller types- mode of controllers- cascade, split range, ratio etc. - P/PI/PID controllers and control tuning- process optimization by APC/DMC- DCS/PLC systems.		
Unit-IV	REFINERY UNIT INTEGRATION AND RECENT TRENDS	(9)
Overall modern refinery flow sheet- products routing- naphtha utilization route up and integration- Diesel/gasoline/ATF/kerosene route up to blending header- Blending processes-line blending- Blending of diesel and MS calculation- LP model for blending operation- Recent trends in ADU with pre flash- RFCC-OHCU-Prime G+-catalytic dewaxing- PSA technology-DWC technology- Blue H ₂ process-Pre reforming- moving bed in CRU and isom-Advanced lube processing.		

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Unit-V	ENERGY SAVING AND REFINERY ECONOMICS	(9)
Furnace efficiency calculation-steam utilization- plume length- insulation of pipelines- heat tracing-steam traps-Standard Refinery Fuel Tonnage- Fuel and loss- operational cost- margin cost- refining capacity-complexity factor- crude oil evaluation and procurement-monthly production planning- cracks-Gross Refinery Margin-operation optimization by Linear Programming model-shutdown planning- Refinery Transfer Price-taxation-pricing.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	W. L. Nelson, Petroleum Refinery Engineering,, McGraw-Hill Book Co , 1969.
2	J. H. Gary, H. Hanwerk and M. J. Kaiser, Petroleum Refining Technology and Economics, CRC Press , 5th Edition, 2007.
3	Fundamentals of Petroleum Refining, M.A. Fahim, T.A. Al-sahhaf, A.S. Elkilani; Elsevier Science and Technology.
4	Coughanowr, D. R., & Leblanc, S. E. (2008). Introductory concepts. Process Systems Analysis and Control, 3rd Ed, 1-6.
5	Industrial Instrumentation, Donald P.Eckman, CBS, 2004
6	Smith, R.(2005).Chemical process:design and integration. John Wiley & Sons
7	Corrosion Control in the Oil and Gas Industry 1 st Edition, Sankara Papavinasam, 2013
8	Gilbert, M. Masters., "Introduction to Environmental Engineering and Science", 3rd edition 2008

REFERENCES:

1	Luyben, W. L., Tyréus, B. D., & Luyben, M. L. (1998). Plant wide process control (Vol. 43). New York: McGraw-Hill.
2	Stephanopoulos, G. (1984). Chemical process control (Vol. 2). New Jersey: Prentice hall.
3	Instrumentation and Control Systems, K. Padmaraju, Y.J. Reddy, McGraw Hill Education, 2016
4	Gilbert M. Masters, Introduction to Environmental Engineering and Science, Prentice –Hall India , 2000
5	Petroleum Economics, Jean Masseron, Technip; 4threvised Edition, 2000. (ISBN-10: 2710805979; ISBN-13: 978-2710805977)

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6	Cheremisinoff N.P. and Graffia M.L., "Environmental Health and Safety Management. A Guide to Compliance", Pressure safety de-sign practices for refinery and chemical operations", Jaico Publication. 2003
7	Fontana, M.G., "Corrosion Engineering", Edn 3, McGraw Hill, 1989

COURSE OUTCOMES:

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

CO1:	Understanding the regulations and government policies in refining industries.
CO2:	Acquire some knowledge on advanced techniques, automation and instrumentation techniques.
CO3:	Understand the different controllers and automated control systems in refineries.
CO4:	Gathers knowledge on unit integrations in refineries.
CO5:	Understand the basis on energy saving techniques and refinery economics

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	1	2	1	2	2	2	2	1
CO2	1	1	1	1	1	2	1	2	2	2	2	1	2	1
CO3	1	2	1	2	1	2	1	2	1	2	2	1	2	1
CO4	2	2	1	2	2	2	1	2	1	1	2	1	2	1
CO5	2	2	1	2	2	2	2	2	1	1	2	1	2	1
Avg.	1	2	1	2	1	2	1	2	1	2	2	1	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2405	PETROLEUM EQUIPMENT DESIGN	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To study and analyze suitable equipment for particular reservoir conditions					

Unit-I		(9)
Casing program, casing and tubing design, principles of cementing, completion added skin, well perforating, hydraulic fracturing. DRILL BIT DESIGN.ROLLER CONE BITS.PDC DRILL BITS.NOMENCLATURE AND IADC CODES for drill bits. BHA (Bottom hole assembly). ESP (Electrical submersible pumps). SRP (Sucker rod pumping) unit design.		
Unit-II		(9)
Design of Surface Facilities -Design of production and processing equipment, including separation problems, treating, and transmission systems.		
Unit-III		(9)
Capstone design in the areas of geology, reservoir engineering, production, drilling and well completions to practical design problems based on real field data with all of the associated shortcomings and uncertainties. Use of commercial software.		
Unit-IV		(9)
Oil desalting-horizontal and spherical electrical dehydrators- Natural Gas Dehydration-Horton sphere-Natural Gas Sweetening. Crude & Condensate Stabilization-design of stabilizer- Oil and Gas Treatment. Treating Equipment.		
Unit-V		(9)
Refinery Equipment Design-atmospheric distillation column Design and construction of on/ offshore pipelines, Fields Problems in pipeline, Hydrates, scaling & wax etc and their mitigation.		
Total No of Periods to be Taught	45	

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TEXT BOOK:

1	Petroleum Exploration Hand Book by Moody, G.B.
2	Wellsite Geological Techniques for petroleum Exploration by Sahay.B et al

REFERENCES:

1	Standard Hand Book of Petroleum & Natural Gas Engineering” - 2nd Edition 2005-William C.Lyons & Gary J.Plisga-Gulf professional publishing comp (Elsevier).
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COURSE OUTCOMES:

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

CO1:	Understand the drill bit fundamentals, codes and standards
CO2:	Understand design of production and processing equipment.
CO3:	Understand the Capstone design in reservoir engineering.
CO4:	Understand the design of Oil and Gas Treatment Equipment
CO5:	Understand the design of pipe systems.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	2	2	-	-	3	-	3	-	-
CO2	3	2	3	3	2	3	-	-	-	-	-	3	-	2
CO3	3	2	3	-	2	2	-	-	2	-	-	3	1	-
CO4	3	2	3	2	-	3	-	-	-	1	-	3	-	-
CO5	3	3	3	-	3	2	-	-	-	-	-	3	-	-
Avg.	3	2	3	2	2	2	2	-	2	3	-	3	1	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy

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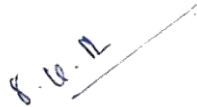


Department	Chemical Engineering	Programme Code & Name	203-CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2406	PETROCHEMICAL TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to learn the operation and methodologies in petrochemical industries •To enable students to learn the application of petrochemicals in all process fields •To enable students learn each products of petrochemical industries and its application with production techniques in detail					

Unit-I	PETROCHEMICALS EVOLUTION	(9)
Petrochemical Industries and their feedstock selection. History, Economics, Growth of petrochemical industry, Structure of Petrochemical complexes, Classification of petrochemicals, Basic building processes, Integration with refinery-flow scheme.		
Unit-II	INTERMEDIATES FOR PETROCHEMICALS INDUSTRIES	(9)
Production Methods - Reforming and cracking of feed stocks; Sources: Chemicals from synthesis gas, olefins and aromatics-Ethylene, Propylene, C4 hydrocarbons, higher olefins, Benzene, Toluene, Xylene and their derivatives		
Unit-III	COMPLEX PETROCHEMICAL PRODUCTS	(9)
Acrylonitrile, Acrylic acid, dimethyl terephthalate, ethanol, ethylene glycol, linear alkyl benzene, methyl tertiary butyl ether, vinyl acetate, vinyl chloride, Maleic and phthalic anhydride, ethyl benzene, Phenol, Cumene, Styrene, Bisphenol, Aniline - Process flow scheme - various technology - advantages-yield pattern-process variables		
Unit-IV	POLYMERS	(9)
Polymers production: Fibers, Rubbers and Plastics. Acrylonitrile butadiene styrene (ABS), polyethylene-LDPE, HDPE, Polypropylene, PVC, PS, SAN, SBR, PAN, Nylon and Polycarbonates.		
Unit-V	GLOBAL CHEMICALS	(9)
Petrochemicals-Lubricants, additives, adhesives, agrochemicals, cosmetics raw materials, electronic chemicals, detergents, paint, healthcare and pharmaceuticals, Fertilizers- Ammonia, Urea, NPK etc.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Bhaskara Rao, B.K. "A Text on Petrochemicals", 2nd Edition, Khanna Publishers, New Delhi, 1998
2	H. Steiner, "Introduction to Petrochemicals", Pergamon Press, New York, 1961.


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3	Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons, 1986
4	IDMall, 'Petrochemical process Technology', Macmillan India Limited, 2007
5	A. Chawvel and G. Lefebvre, "Petrochemical Process", Vol. I & II, Gulf Publishing Co., Houston, London

REFERENCES:

1	Brownstein A.M. "Trends in Petrochemical Technology", Petroleum Publishing Company, 1976.
2	G. Margaret Wells, 'Handbook of Petrochemicals and Processes' 2nd Revised Edition, Gower Publishing Company
3	Groogins, "Unit Process in Organic Synthesis", McGraw Hill Book Company, New York
4	Robert A. Meyers, "Handbook of Petrochemicals Production Processes", McGraw-Hill Education: New York, 2nd edition, 2019 (ISBN: 9781259643132)
5	L.F. Hatc and MatarSarri, "From Hydrocarbons to Petrochemicals", Gulf Publishing Co., Houston, London
6	A.L. Waddams, "Chemicals from Petroleum", Gulf Publishing Company, London, 4th edition, 1980

COURSE OUTCOMES:

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

CO1:	Able to understand the basic knowledge on petrochemical industry and their growth, history.
CO2:	Understand the different methods of production in petrochemical products and their derivatives.
CO3:	Gather knowledge on the production of complex petrochemical products
CO4:	Able to understand the petrochemical industries and its application with production techniques in polymers.
CO5:	To understand the application of petrochemicals in all process fields.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	2	2	2	1	1	1	2	2	1
CO2	2	2	1	1	2	2	2	2	2	1	1	2	2	2
CO3	2	2	1	1	2	2	2	2	1	1	1	2	2	1
CO4	2	2	2	1	2	2	1	3	1	2	1	2	2	1
CO5	1	2	1	1	2	2	1	3	1	2	1	2	2	1
Avg.	2	2	1	1	2	2	1	2	1	1	1	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2407	BIOENERGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To enable the students to learn the biomass sources, classification, characteristics & preparation. • To enable students to kinetics and mechanism of biogas production. • To enable students to know the pyrolysis and thermo-chemical conversion.					

Unit-I		(9)
Biomass sources and classification; Biomass characteristics & preparation; Chemical composition and properties of biomass; Size reduction, Briquetting of loose biomass, Drying, Storage and handling of biomass.		
Unit-II		(9)
Biogas technology: Feedstock for producing biogas; Microbial and biochemical aspects and operating parameters for biogas production, Kinetics and mechanism. Dry and wet fermentation, Digestors for rural application-High rate digesters for industrial waste water treatment.		
Unit-III		(9)
Pyrolysis and thermo-chemical conversion: Thermo-chemical conversion of lignocellulosic biomass. Incineration for safe disposal of hazardous waste, Biomass processing for liquid fuel production, Pyrolysis of biomass-pyrolysis regime, effect of particle size, temperature, and products obtained.		
Unit-IV		(9)
Gasification of biomass: Thermochemical principles: Effect of pressure, temperature and introducing steam and oxygen. Design and operation of Fixed and Fluidised Bed Gasifiers, Safety aspects.		
Unit-V		(9)
Combustion of biomass and cogeneration systems: Combustion of woody biomass-theory, calculations and design of equipment, Cogeneration in biomass processing industries. Case studies: Combustion of rice husk, Use of bagasse for cogeneration.		
Total No of Periods to be Taught	45	

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TEXT BOOK:

1	Anju Dahiya, Bioenergy: Biomass to biofuels First Edition, Academic Press, 2014.
2	Li, Yebo, and Samir Kumar Khanal. Bioenergy: principles and applications. John Wiley & Sons, 2016.

REFERENCES:

1	Vaughn C Nelson, Kenneth L. Starcher. Introduction to bioenergy. CRC Press, 2017.
2	Wall, Judy D., Caroline S. Harwood, and Arnold Demain. "Bioenergy." Bioenergy.. ASM Press, 2008.

COURSE OUTCOMES:

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

CO1:	Understand the fundamental knowledge on classification, characterization and sources of biomass.
CO2:	Learn the production of biogas
CO3:	Gather knowledge on the operations of incineration, pyrolysis.
CO4:	Understand the process in gasification of biomass.
CO5:	Knowledge on the types of combustion of biomass.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	2	2	1	1	1	1	2	1	2
CO2	2	-	2	1	2	2	2	1	1	1	2	2	2	2
CO3	2	1	2	1	2	2	2	2	1	1	2	2	1	2
CO4	2	1	2	1	2	2	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	2	1	1	1	2	2	1	2
Avg.	2	1	2	1	2	2	2	1	1	1	1	2	1	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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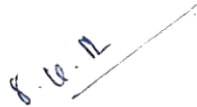


Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2408	RENEWABLE ENERGY RESOURCES	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To enable the students to learn the brief history of energy consumption. • To enable students to basics of solar energy. • To enable students to know the bio degradation and biogas generation.					

Unit-I		(9)
Introduction: Energy: Past, Today, and Future. A brief history of energy consumption. Energy & Environment. Renewable Energy – Quality, quantity, availability, advantageous and limitations.		
Unit-II		(9)
Solar energy: Sun and its Energy: Basics of Solar Energy. Solar Energy in the Past. Solar Thermal Energy Solar Photovoltaic.		
Unit-III		(9)
Bio energy & Geothermal energy: Conversion. Bio degradation. Biogas generation. Fuel properties. Biomass gasifier. Geothermal Resources, Geothermal Technologies.		
Unit-IV		(9)
Wind energy: Wind Resources. Wind Turbines. Environmental Impact. Data and energy estimation. Conversion. Wind mill Performance and applications.		
Unit-V		(9)
Tidal energy; Ocean Energy Potential against Wind and Solar. Wave Characteristics and Statistics. Wave Energy Devices. Tide Energy Technologies. Ocean Thermal Energy. Osmotic Power.		
Total No of Periods to be Taught	45	

TEXT BOOK:	
1	Mukherjee, D., and S. Chakrabarti. <i>Fundamentals of renewable energy systems</i> . New Age International, 2004.
2	Jenkins, Nicholas, and Janaka Ekanayake. <i>Renewable energy engineering</i> . Cambridge University Press, 2017.


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REFERENCES:

1	Kishore, V. V. N., ed. Renewable energy engineering and technology: principles and practice. The Energy and Resources Institute (TERI), 2010.
2	Tiwari, Gopal Nath, and Rajeev Kumar Mishra. Advanced renewable energy sources. Royal Society of Chemistry, 2012.

COURSE OUTCOMES:

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

CO1:	Understand the fundamental knowledge on history, consumption of energy
CO2:	Learn the production of solar energy
CO3:	Gather knowledge on the geothermal and bio energy
CO4:	Understand the production of wind energy and their utilization
CO5:	Knowledge on the production and utilization of tidal energy

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	2	1	1	1	2	2	2	2
CO2	1	1	2	2	2	2	2	1	1	1	2	2	2	2
CO3	1	2	2	2	2	2	1	1	1	1	2	2	2	2
CO4	1	2	2	2	2	2	1	1	1	1	2	2	1	1
CO5	1	2	2	2	2	2	1	1	1	1	2	2	2	1
Avg.	1	1	2	2	2	2	1	1	1	1	2	2	2	2

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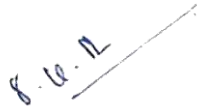


Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2409	PINCH TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	To create awareness about alternate energy and resource analysis. To familiarize the students with the concepts o thermodynamics and design methodology					

Unit-I		(9)
Thermodynamic review of the process, Pinch Concept, significance of pinch, pinch in grid representation, Threshold problems, capital cost implication of the pinch		
Unit-II		(9)
Targeting: Heat exchanger networks, energy targeting, area targeting, unit targeting, shell targeting, cost targeting, super targeting, continuous targeting		
Unit-III		(9)
Pinch Methodology: Problem representation, temperature enthalpy diagram, simple match matrix. Heat content diagram, Temperature interval diagram.		
Unit-IV		(9)
Pinch Design and Optimization: Networks for maximum energy recovery, Pinch design method, Flexibility criteria of the pinch, CP table, heuristics, optimization of heat exchanger network: optimality for a minimum area network.		
Unit-V		(9)
Energy and Resource Analysis of various processes, Batch process, distillation process, evaporation process, reaction process, process using mass separating agent.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	V. Uday Shenoy" Heat Exchanger network synthesis" Gulf Publishing Co, USA, 1995.
REFERENCES:	
1	D.W. Linnhoff et al., "User Guide on Process Integration for the efficient use of Energy", Institution of Chemical Engineers, U.K., 1994.


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2	James M. Douglas "Conceptual Design of Chemical Process", McGraw Hill, New York, 1988
3	Anil Kumar, "Chemical Process Synthesis and Engineering Design", Tata McGraw Hill New Delhi, 1977.

COURSE OUTCOMES:

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

CO1:	Understand the pinch concept and process thermodynamics
CO2:	Identify minimum energy targets
CO3:	Classify different choices and constraint during heat exchange networking
CO4:	Apply strategies for retrofitting existing process plant, integration of energy demands of multiple processes
CO5:	Analyze the concepts in various chemical processes.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	1	2	2	1	1	1	1	2
CO2	1	2	1	1	2	2	1	2	2	1	1	1	2	2
CO3	1	2	2	1	3	3	1	2	2	1	1	1	2	2
CO4	1	2	2	1	3	3	2	2	2	1	1	1	2	2
CO5	1	2	2	2	3	3	1	2	2	1	1	1	2	2
Avg.	1	2	2	1	2	2	2	2	2	1	1	1	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2410	HYDROGEN AND FUEL CELL TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	To create awareness about alternate clean fuel available. To familiarize the students with the concepts and chemistry of fuel cell					

Unit-I	INTRODUCTION	(9)
Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work Potentials, prediction of reversible voltage, fuel cell efficiency, Types of fuel cells.		
Unit-II	FUEL CELL KINETICS	(9)
Fuel cell reaction kinetics - electrode kinetics, overvoltage, Tafel equation, charge transfer reaction, exchange currents, electro catalysis - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.		
Unit-III	CHARACTERIZATION TECHNIQUES	(9)
Fuel cell characterization - in-situ and ex-situ characterization techniques, i-V curve, frequency response analysis; Fuel cell modeling and system integration: - 1D model – analytical solution and CFD models.		
Unit-IV	RENEWABLE SOURCES	(9)
Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.		
Unit-V	APPLICATION OF FUEL CELLS	(9)
Fuel cell power plants: fuel processor, fuel cell power section (fuel cell stack), power conditioner; automotive applications, portable applications		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Gregor Hoogers, "Fuel Cell Technology Handbook", CRC Press, 2003.
2	R.P. O'Hayre, S. Cha, W. Colella, F.B. Prinz, "Fuel Cell Fundamentals", Wiley, 2006.
3	A. J. Bard, L. R. Faulkner, "Electrochemical Methods", Wiley, 2004.
REFERENCES:	
1	S. Basu, "Fuel Cell Science and Technology", Springer, 2007.
2	H. Liu, "Principles of Fuel Cells", Taylor & Francis, 2006.

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COURSE OUTCOMES:

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

CO1:	Aware of alternate energy sources and its importance of it.
CO2:	Understand the fuel cell kinetics
CO3:	Able to understand the characterization techniques
CO4:	Analyze the renewable sources and storage
CO5:	Understand the applications of fuel cells in various fields.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	2	2	1	1	1	2	2	2	2
CO2	2	2	2	3	1	2	2	1	2	1	2	2	2	2
CO3	2	2	2	3	3	2	2	1	2	1	2	2	2	2
CO4	2	2	2	3	3	2	2	1	2	2	2	2	2	2
CO5	2	2	2	3	3	2	2	1	1	1	2	2	2	2
Avg.	2	2	2	3	2	2	2	1	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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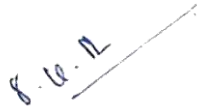


Department	Chemical Engineering	Programme Code & Name	203 -CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2411	POWER PLANT ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	To understand the knowledge about the power plant boiler and gas turbine. To familiarize the students with the knowledge on the application of integration of various process in power plants					

Unit-I		(9)
Boiler Classification - Boiler Types - Fire Tube & Water Tube Boilers - Fluidized Bed Boilers - Positive Circulation Boilers - Thermal Liquid Heaters & Vaporizers		
Unit-II		(9)
Boiler Classification - Boiler Types - Fire Tube & Water Tube Boilers - Fluidized Bed Boilers - Positive Circulation Boilers - Thermal Liquid Heaters & Vaporizers		
Unit-III		(9)
Steam Turbines: Classification - Features - Working – Performance; Losses in Steam Turbines - Trouble Shooting		
Unit-IV		(9)
Gas Turbines: Classification and Comparison of Different Types Gas Turbine Power Plants Components - Economics & Future of Combined Cycles		
Unit-V		(9)
Integrated Gasification Combined Cycle (IGCC) – Indirect Fired Combined Cycle (IFCC) – Magneto Hydrodynamics (MHD) – Fuel Cells – Micro turbines– RDF based power plants.		
Total No of Periods to be Taught	45	

TEXT BOOK:	
1	Thomas C. Elliott , "Standard Hand Book of Power Plant Engineering"
REFERENCES:	
1	E L Wakil, "Power Plant Engineering", McGraw-hill Book Co, N.Y. 2001
2	Arora and Domkundwar, A course in Power Plant Engineering, Dhanpat Ra, N.Delhi.2003
3	Nag, P.K., "Power Plant Engineering", 2 nd Edition, TMH, 2001


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COURSE OUTCOMES:

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

CO1:	Understand the fundamental knowledge on components, layouts and working of power plants
CO2:	Learn the types, classification and usage of boilers
CO3:	Gather knowledge on classification and usage of steam turbines
CO4:	Understand the types of gas turbines
CO5:	Knowledge on the application of integration of various process in power plants

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	2	1	1	1	1	1	2	2	2
CO2	2	2	2	2	2	2	2	1	1	2	1	2	2	2
CO3	2	2	2	2	2	2	2	1	1	1	1	2	2	2
CO4	2	2	2	2	2	2	2	2	1	-	1	2	2	2
CO5	2	2	2	2	2	2	3	2	1	1	1	2	2	2
Avg.	2	2	2	2	2	2	2	1	1	1	1	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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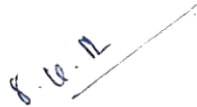


Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2412	NON-RENEWABLE ENERGY SOURCES	L	T	P	C	100
		3	0	0	3	
Course Objectives	To understand the knowledge about the petroleum, natural gas and nuclear energy. To familiarize the students with the knowledge on the knowledge on the usage of nuclear reactors, nuclear waste management and safety usage.					

Unit-I	PETROLEUM	(9)
Origin of Petroleum, Composition, Extraction of Petroleum. Products of Petroleum refining: Diesel; Gasoline; LPG; Fuel oil; Tar; and Bitumen. Environmental Issues associated with petroleum resources.		
Unit-II	COAL	(9)
Types of coal; Composition of coal; Oxygen content, Proximate and Ultimate Analysis of coal; Carbonization, Coal for generation of electricity, coal liquefaction, coal blending. Environmental Issues associated with usage of coal.		
Unit-III	NATURAL GAS	(9)
Resources of for Natural Gas, Properties and classification of natural gas, transportation of natural gas, products from natural gas, liquefied natural gas, chemicals from natural gas, shale gas; Environmental Issues associated with usage of coal.		
Unit-IV	NUCLEAR ENGINEERING FUNDAMENTALS	(9)
Nuclear models, binding energy, Radio activity, half-life, mechanism of nuclear fission and fusion, decay chains, neutron reactions. Nuclear Fuels; Nuclear fuel reserves of Uranium and Thorium, Nuclear fuel cycles, characteristics, production and purification, other fuels Zirconium, Beryllium.		
Unit-V	NUCLEAR ENERGY	(9)
Nuclear reactors and classification, boiling water reactors (BWR), pressurized heavy water reactor (PHWR), fast breeder reactor (FBR), basics of nuclear fusion reactor. Nuclear Power Plant –Waste Management and Safety		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Breeze, Paul. Nuclear power. Academic Press, 2016.
2	Viswanathan, Balasubramanian. Energy sources: fundamentals of chemical conversion processes and applications. Newnes, 2016.


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3	Rao, S., and B. B. Parulekar. "Energy Technology: Non-conventional, Renewable and Conventional. " Khanna Publication, 3rd (2012).
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COURSE OUTCOMES:

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

CO1:	Understand the fundamental knowledge on petroleum and its products
CO2:	Learn the usage of coal, types and its composition
CO3:	Gather knowledge on the properties, classification and products of natural gas
CO4:	Understand the fundamentals of nuclear engineering
CO5:	Knowledge on the usage of nuclear reactors, nuclear waste management and safety usage.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	1	2	1	2	-	1	2	2	2
CO2	2	2	2	1	1	1	2	1	2	-	1	2	2	2
CO3	2	2	2	1	1	1	2	1	2	1	2	2	2	2
CO4	2	2	2	1	1	1	2	1	2	1	2	2	2	2
CO5	2	2	2	1	1	1	2	1	2	3	3	2	2	2
Avg.	2	2	2	1	1	1	2	1	2	1	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2413	BIOCHEMISTRY	L	T	P	C	100
		3	0	0	3	
Course Objectives	To enable students learn the fundamentals of Biochemical Processes and Biomolecules.					

Unit-I	INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES:	(9)
Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate		
Unit-II	STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES	(9)
Structure and properties of Important Biomolecules. Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins. Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure. Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes		
Unit-III	METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM	(9)
Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt.		
Unit-IV	INTERMEDIARY METABOLISM AND REGULATION	(9)
Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.		
Unit-V	PROTEIN TRANSPORT AND DEGRADATION	(9)
Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.		

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Total No of Periods to be Taught	45
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TEXT BOOK:	
1	Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox W.H. Freeman and Company 2017
2	Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.
3	Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
4	Conn, E.E., et al., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.
5	Outlines of Biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. Pp 693. John Wiley and Sons, New York. 1987.

REFERENCES:	
1	Berg, Jeremy M. et al. "Biochemistry", 6th Edition, W.H. Freeman & Co., 2006.
2	Murray, R.K., et al "Harper's Illustrated Biochemistry", 31st Edition, McGraw-Hill, 2018.
3	Voet, D. and Voet, J.G., "Biochemistry", 4th Edition, John Wiley & Sons Inc., 2010.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Understand the basic concepts on carbohydrates.
CO2:	Learn the concepts of proteins.
CO3:	Gather knowledge on importance of nucleic acids.
CO4:	Understand the knowledge on lipids.
CO5:	Gather knowledge on intermediary metabolism and their pathways.

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	2	1	2	2	1	1	2	2	2
CO2	2	-	-	-	-	2	1	2	2	1	1	2	2	2
CO3	2	-	-	1	1	2	1	2	2	1	1	2	2	2
CO4	2	-	-	1	1	2	1	2	2	1	1	2	2	2
CO5	2	1	1	1	2	2	1	2	2	2	2	2	2	2
Avg.	2	1	1	1	1	2	1	2	2	1	1	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2414	BIOPROCESS TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the fundamentals of bioprocesses - To understand the production process of biomolecules - To have a strong foundation in bioreactors.					

Unit-I	INTRODUCTION TO BIOPROCESS	(9)
Biologists and Engineers, comparison of chemical and biochemical processing overview of biological basics, About cells and its growth, the stoichiometry of microbial growth and product Bioprocesses: Regulatory Constraints		
Unit-II	MEDIA FORMULATION AND DEVELOPMENT	(9)
Media formulation, Media Sterilization: Methods of heat sterilization of media, thermal death kinetics, design criteria, batch and continuous sterilization. Air Sterilization: Methods of air sterilization, mechanism of air sterilization, solid and liquid handling. Industrially fermented broth		
Unit-III	UNDERSTANDING BIOREACTORS	(9)
Purpose and importance of bioreactors, Classification of bioreactors, bioreactors for animal cells, bioreactors for plant cells, bioreactors for immobilized cells, operations of bioreactors, stirred tank reactor, plug flow reactor (PFR), fluidized bed reactor, bubble column, airlift reactor, Agitation, and Aeration: Mechanical agitation, power consumption in agitation, bubble aeration, bioreactors for waste management		
Unit-IV	TRANSPORT PROCESSES	(9)
Aspects of rheology, Fluid flow in packed-bed and Fluidized bed columns, Gas-liquid mass transfer in cellular systems Diffusivity and mechanism of mass transfer - derivation of the equations of mass transport by diffusion-stationary and unsteady mass transport by diffusion, mass transfer coefficient, macroscopic balances for mass transport. Mechanisms and applications of heat transfer-mode of heat transfer-conduction, convection and radiation, Application of Heat and Mass transfer in biochemical processes.		
Unit-V	BIOETHICS AND BIOSAFETY	(9)
Introduction to Bioethics. Social and ethical issues, the process of biotechnology involved in generating new forms of life for informed decision making, Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues. Use of genetically modified organisms and their release into the environment.		



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Total No of Periods to be Taught	45
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TEXT BOOK:	
1	Bailey, J. E., and D. F. Ollis. Biochemical Engineering Fundamentals. 2nd ed. New York, McGraw-Hill, 1986.
2	H. W. Blanch and D. S. Clark, Biochemical Engineering, Marcel, Dekker Inc., 1996.
3	Pauline M. Doran. Bioprocess Engineering Principles. 2nd ed. Elsevier Science & Technology Books. 1995

REFERENCES:	
1	Transport Phenomena, by Bird R.B., Steward W.E., and Lightfoot E.N., John Wiley & sons, Inc., New York, 2002
2	C J Geankoplis, Transport Processes and Separation Processes Principles, 4th Edition, New Jersey, PHI Publishers, 2010

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Understand the fundamental knowledge on bioprocess technology.
CO2:	Learn the the production process of biomolecules.
CO3:	Gather knowledge on the operations of bioreactors and their purposes.
CO4:	Understand the transportation processes in reactors and their behaviours.
CO5:	Knowledge on the biosafety and information on bioethics.

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	2	2	1	1	1	2	2	2	2
CO2	2	2	2	2	1	2	2	2	1	1	2	2	2	2
CO3	2	3	3	2	2	2	2	2	1	1	2	2	2	2
CO4	2	3	3	2	2	2	2	2	1	2	2	2	2	2
CO5	2	1	1	2	2	2	3	3	2	2	2	2	2	2
Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2415	FERMENTATION AND BIOPROCESSING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand fermentation and its kinetics - To understand structural, functional properties of microbes - To design fermenter with auxiliaries					

Unit-I	FERMENTATION PROCESSES	(9)
Importance of fermentation, Fermentation and redox potential, solid-liquid fermentation, solid state fermentation, Kinetics of fermentations, Biosensors for fermentations, Production processes in fermentation..		
Unit-II	MICROBIAL GROWTH KINETICS	(9)
Diversity of patterns of microbial growth in situ and ex situ, Microbial growth under homogeneous conditions, Heterogeneous microbial growth, Growth kinetics, Derivation of mathematical models, and identification		
Unit-III	DESIGN OF FERMENTERS	(9)
Fermentation processes, Fermentation processes and microorganisms, Kinetics and stoichiometry, Mass balances and design for batch, continuous and fed-batch reactors, Comparison of batch, continuous and fed-batch reactors, Heat generation and heat balances, examples of industrial fermentation processes		
Unit-IV	INSTRUMENTATION AND CONTROL	(9)
Common Instruments for Process Automation – Temperature, Gas Flowrate, Liquid Flowrate, Off- Gas Analysis, pH, Dissolved Oxygen, Pressure, Foam Level, Stirring , Redox Potential, Advanced Instrumentation for Bioprocess Control and Automation - Flow Injection Analysis, Sequential Injection Analysis Fluorescence, Mass Spectrometry, Near Infrared Spectroscopy, Soft sensors, Biomass, Bioreactor automation		
Unit-V	FERMENTATION AND COMMODITY PRODUCTS	(9)
Engineering of Secretory Pathways, production of heterologous proteins, fungal, yeast fermentation of industrial products.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Essentials in Fermentation Technology, Aydin Berenjian, Springer ,2019..
2	Principles of Fermentation Technology (Second Edition), Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Pergamon, 1995.

REFERENCES:

1	Fermentation and Biochemical Engineering Handbook; Editors-in-Chief: Henry C. Vogel and Celeste M. Todaro, Third Edition, Elsevier, 2014.
2	Fermentation Biotechnology: Principles, Processes, and Products (Prentice Hall advanced references series), Owen P. Ward, Prentice Hall, 1989.

COURSE OUTCOMES:

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

CO1:	Understand the structural, functional properties of microbes.
CO2:	Learn the growth kinetics of microorganisms.
CO3:	Understand the basic concepts in designing of fermenters.
CO4:	Gather knowledge on the operation of control systems in fermentation and bioprocess industry.
CO5:	Acquire knowledge on the commodity, fermentation production and their production pathways.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	2	2	1	1	2	1	-	-
CO2	1	2	1	2	2	2	2	2	1	1	2	1	2	1
CO3	1	2	3	3	3	2	2	2	1	2	2	1	2	1
CO4	1	2	3	3	3	2	2	2	2	2	2	1	2	1
CO5	1	2	2	2	3	2	2	2	2	2	2	1	2	1
Avg.	1	2	2	2	2	2	2	2	1	2	2	1	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2416	BIOSEPARATION AND DOWNSTREAM PROCESSING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To learn the fundamentals of bio separations • To design unit operations steps for various downstream purification steps • To gain knowledge on theory, design, and application of bioprocessing					

Unit-I	INTRODUCTION	(9)
Introduction to By-products and Bioseparation: Range and characteristics of bio products, Characteristics of Fermentation Broth, Selection of unit operation with due consideration of the physical, chemical and biochemical aspects of biomolecules. Stages of Downstream Processing		
Unit-II	CENTRIFUGATION AND FILTRATION	(9)
Primary Separation: Removal of insoluble and Biomass (and particulate debris) separation techniques, Flocculation and sedimentation, Centrifugation-Ultracentrifugation, Gradient centrifugation, Filtration: Theory of Filtration, Pre-treatment of Fermentation Broth, Filter Media and Equipment, Conventional and Cross-flow Filtration, Continuous Filtration, Filter cake resistance, specific cake resistance, Washing and dewatering of filter cakes		
Unit-III	ABSORPTION	(9)
Gas Absorption: Solubility of gases in liquids, Effect of temperature and pressure on solubility, Ideal and Non-ideal solutions, Choice of solvent for gas absorption, absorption factor, stripping factor, minimum gas liq ratio, Single stage gas absorption Cross Current, Co- current, Countercurrent, Multistage Counter current Operation, Absorption with Chemical Reactions, Related problems		
Unit-IV	EXTRACTION	(9)
Liquid-Liquid Separation Process: Single Stage Operation, Equipments for liquid-liquid extraction. Types of extraction processes: Reactive extraction, Aqueous two-phase systems, Reverse micellar extraction, solid-liquid extraction, Supercritical fluid Extraction. Different types of extractors and designing of extractors. Distillation: Simple, Steam and Equilibrium distillation, Fractionation, McCabe Thiele method, azeotropes,		
Unit-V	CHROMATOGRAPHY AND MEMBRANE SEPARATION	(9)
Theory of chromatography, Shape and yield of a chromatographic peak, Binary chromatography, Hydrodynamic chromatography. Membrane-based bioseparation - Classification of membrane processes, Ultrafiltration, Microfiltration, Dialysis, Liquid membrane processes, Membrane chromatography, Electrophoresis, Affinity ultrafiltration, Field-flow fractionation		

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Total No of Periods to be Taught	45
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TEXT BOOK:	
1	Treybal R.E. , Mass transfer operation, 3 Ed., McGraw Hill New York, 1980.
2	Roger G. Harrison, Paul Todd, Scott R. Rudge, Demetri P. Petrides, Bioseparations Science and Engineering, Oxford University Press
3	B.Shivshankar, Bioseparations: Principles and Techniques, Eastern Economy Edition, PHI Learning Pvt. Ltd., Publishing House, New Delhi, 2012
4	Bioseparation & bioprocessing (2nd Ed) 2-Volume set, Ed SUBRAMANIAN Ganapathy, Wiley-VCH, (09-2007)

REFERENCES:	
1	P.A. Belter, E.L. Cussler and Wei-Shou Hu., Bioseparations-Downstream Processing for Biotechnology, Wiley Interscience Publication, 1988.
2	R. K. Scopes, Berlin, Protein Purification: Principles and Practice, Springer, 1982. Scopes Ak, Protein Purification, IRL Press, 1993
3	Biotechnology: Bioprocessing, Rhem and Reed, Vol. 3, 1993
4	Separation and purification techniques in biotechnology, Fredreich Dechow, 1989
5	T. Schepler et al, Biotreatment, Downstream Processing and Modeling (Advances in Biochemical Engineering /Biotechnology, Vol 56) by Springer Verlag

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Understand the basic concept of bioseparation processes
CO2:	Acquire knowledge on theory, design, and application of bioprocessing
CO3:	To understand the basic concepts absorption and their problems in bioprocessing
CO4:	Gather knowledge on extraction of bioproducts using different methods
CO5:	Acquire knowledge on chromatography techniques and their analysis, membrane separation process

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	2	2	2	2	2	2	1	2
CO2	2	2	2	2	3	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	3	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	1	2	2	2	2	2
CO5	2	3	2	3	3	2	2	2	1	2	2	2	2	2

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Avg.	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy														

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2417	ENZYME IMMOBILISATION TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To understand Enzymes, homogeneity, and heterogeneity • To understand structural, functional properties, and metabolic pathways • To learn immobilization procedures, and types • To design enzyme reactors					

Unit-I	INTRODUCTION	(9)
Catalysis and biocatalysis, Enzyme classification and nomenclature, enzyme structure, functionality and relationship, enzyme activity, enzyme sources, synthesis, recovery and purification, enzymes as process catalysts.		
Unit-II	HOMOGENEOUS ENZYME KINETICS	(9)
Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of kinetic inhibition, reactions with more than one substrate, effect of environmental variables- pH, temperature, and ionic strength.		
Unit-III	BASICS OF IMMOBILISATION	(9)
Immobilisation – Functional properties, Classification of Immobilisation techniques – Adsorption, matrix entrapment, crosslinking, covalent binding- advantages & disadvantages of each method, selection and characterisation of matrices for immobilisation, effect of physico chemical parameters on immobilised enzymes.		
Unit-IV	HETEROGENEOUS ENZYME KINETICS	(9)
Mass transfer effects in heterogeneous biocatalysis, partition effects, Immobilised enzyme kinetics - external (film) diffusion, internal (pore) diffusional kinetics, Thiele modulus and Effectiveness factor. Effects of electrostatic potential of the micro environment.		
Unit-V	ENZYME REACTORS & APPLICATION OF IMMOBILISED ENZYMES	(9)
Design of reactors with immobilised enzymes, Design of advanced immobilized enzyme systems, Application of immobilised enzymes in food industry, textile industry, Pharmaceutical industry & in medicine, in the production of biofuels, detergent industry, production of various bio-products, as biosensors.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	"Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990. (Website for the book, www.lsbu.ac.uk/biology/enztech/)
2	"Biocatalysts and Enzyme Technology" by K. Buchholz,V. Kasche and U.T. Bornscheur, Wiley,2005

REFERENCES:

1	"Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008
2	Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer,2008

COURSE OUTCOMES:

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

CO1:	Understand the basic knowledge on classification of enzymes and their nomenclature.
CO2:	Understand Enzymes, homogeneity, and heterogeneity.
CO3:	Understand structural, functional properties, and metabolic pathways of enzymes.
CO4:	Learn immobilization procedures, and their different types.
CO5:	Knowledge on designing enzyme reactors.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	1	2	1	1	-	1	2	1	1
CO2	2	-	1	1	1	1	2	1	1	-	1	2	1	1
CO3	2	-	1	1	1	1	2	1	1	-	1	2	1	1
CO4	2	2	2	1	2	1	2	1	1	-	1	2	1	1
CO5	2	2	3	2	2	2	2	2	1	2	1	2	1	1
Avg.	2	1	2	1	1	1	2	1	1	1	1	2	1	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2418	BIOREACTOR DESIGN	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the fundamentals of bioreactor design - To design single and multiple bioreactors - To design enzyme reactors					

Unit-I	BIOREACTOR DESIGN & MEDIA REQUIREMENTS	(9)
Microbial growth and product formation kinetics, Bioreactor Selection, Reactor operational mode and selection.		
Unit-II	DESIGN EQUATIONS FOR BIOREACTORS	(9)
Basic Design Equations/ Mole Balances: Batch, Fed-Batch and Repetitive Batch Reactors, Continuous: Stirred tank and tubular flow reactors, Microbial death kinetics, Design criterion for sterilization, Batch and continuous sterilization of medium, Multiple reactions-series, parallel and mixed-mode, Air sterilization		
Unit-III	BIOREACTOR REQUIREMENTS	(9)
Process-General requirements; Basic design and construction of bioreactors and their ancillaries; Material of construction, Vessel geometry, Bearing Assemblies, Motor drives, Aseptic seals; Flow measuring devices, Valves, Agitator and Sparger Design, Sensors, Non-isothermal homogeneous reactor systems. Adiabatic reactors, batch and continuous reactors, optimum temperature progression		
Unit-IV	DESIGN OF BIOREACTORS	(9)
Process and mechanical design of Bioreactors, volume, sparger, agitator-type, size and motor power, heat transfer calculations for coil and jacket, sterilization system, scale-up, scale down, bioinstrumentation and control.		
Unit-V	NOVEL BIOREACTORS DESIGN	(9)
Design of Immobilized enzyme packed bed Reactor. Fluidized bed reactors, Slurry Reactors, Airlift & Loop reactors, Packed bed and Hollow fiber membrane bioreactors, Bioreactors for waste treatment processes; SSF bioreactors. bioreactor design considerations for plant and animal cell cultures.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Bioprocess Engineering -Kinetics, Mass Transport, Reactors and Gene Expression Wolf R. Vieth A Wiley-Interscience Publication 1994.
2	Chemical Kinetic Methods: Principles of relaxation techniques Kalidas C New Age International 1996.
3	Chemical Reactor Analysis and Design Forment G F and Bischoff K B John Wiley 1990.

REFERENCES:

1	Bioprocess Engineering -Kinetics, Biosystems, sustainability and reactor Design, Shijie Liu, Elsevier Publication 2013.
2	Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer,2008.

COURSE OUTCOMES:

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

CO1:	Compare kinetics and reaction rates for various bioreactor designs, based on operational mode and type of substrate.
CO2:	Differentiate and estimate productivity in commercial bioreactors- packed bed, fed batch reactors.
CO3:	Helps to understand various requirements such as material of construction, valves, agitator, sensors etc.
CO4:	Understanding the mechanical design and heat transfer calculations for various type of bioreactor.
CO5:	Analyze immobilization techniques in reactors and use it for various applications.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	2	2	2	2	2	2	2	2	2
CO2	2	2	2	3	3	2	2	2	2	2	2	2	3	2
CO3	2	2	2	3	3	2	2	2	2	2	2	2	3	2
CO4	2	2	3	3	3	2	2	3	2	2	2	2	3	2
CO5	2	2	3	3	3	2	2	3	2	2	3	2	3	2
Avg.	2	2	2	3	3	2	2	3	2	2	2	2	3	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2419	AIR POLLUTION ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	To enable the students to learn about Air Pollution, effects of air pollution, Global effects, Sampling of pollutants, Meteorology and air pollution, Atmospheric stability, Plume rise and dispersion and Prediction of air quality .					

Unit-I	INTRODUCTION	(9)
Introduction to Air Quality; An Overview of the Clean Air Act Amendments; Air Pollution Regulatory Framework - Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments. Ambient Air Quality Standards in India; Properties of Air Pollutants; Sources and effects of air pollution, emission standards, Air Quality Index		
Unit-II	GASEOUS POLLUTANTS	(9)
Absorption- Principles, Description of equipment-Packed and Plate columns -Design and Performance equations; Adsorption- Principle Adsorbents, Equipment descriptions - PSA - Adsorption cycle - Solvent recovery system-Continuous Rotary bed, Fluidized bed, Design and Performance equations ; Incinerators, Hydrocarbon incineration kinetics- Equipment description- Design and Performance equations.		
Unit-III	PARTICULATE AIR POLLUTION	(9)
Particle Collection mechanisms– Fluid particle Dynamics – Particle size Distribution – Efficiency – Gravity Settling chambers Cyclones- Electrostatic precipitators and Bag houses		
Unit-IV	AIR POLLUTION CONTROL	(9)
Principles of Pollution Prevention- Characteristics and control of VOCs and HCs, Characteristics and control of sulphur oxides and nitrogen oxides, Control of mobile source pollutants - Control of particulate matters – Techniques of air pollution control - equipments		
Unit-V	AIR POLLUTION MODELLING	(9)
Meteorology and winds- Stability of the atmosphere, lapse rates & inversions- Air pollution dispersion models, Gaussian equation and variation, Industrial Air Pollution Sources and Prevention		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Richardw.Boubeletal.,“Fundamentals of Air Pollution”,Academic Press,New York,1994.
2	NoelDeNevers,“Air Pollution Control Engg.”,McGrawHill,New York,1995.
3	M.N.Raoetal.,“Air Pollution”TataMcGrawHill,1989.

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REFERENCES:

1	David, H.F., Liu, Bela G., Liptak Air Pollution, Lweis Publishers, 2000.
2	Stern, A.C., Air Pollution (Vol.I – Vol.VIII), Academic Press, 2006.
3	Davis, W.T., Air Pollution Engineering Manual, John Wiley & Sons, Inc., 2000.
4	Heck, R.M., and Farrauto, R.J., Catalytic Air Pollution Control: Commercial Technology, 2nd Edition John Wiley Sons, 2012
5	Pierce, J.J., Environmental pollution and control, Butterworth-Heinemann, 4th edn, 1997.
6	Nevers, N., Air Pollution Control Engineering, McGraw Hill, New York, 2011.
7	Anjaneyulu, Y., Air Pollution and Control Technologies, Allied Publishers (P) Ltd., India, 2002.
8	Wang, L.K., Parelra, N.C., Hung, Y.T., Air Pollution Control Engineering, Tokyo, 2004.

COURSE OUTCOMES:

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

CO1:	Understand the nature and characteristics of air pollutants, and basic concepts of air quality management.
CO2:	Identify, formulate and solve air pollution problems using air pollution control devices to meet applicable standards
CO3:	Understand the knowledge about particulate air pollutants and control devices.
CO4:	Relate the air quality behaviour and its measurement
CO5:	Control the air pollution in industries using various models.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	2	2	2	2	2	2	2	1	2
CO2	2	3	2	2	3	2	2	2	2	2	1	2	2	2
CO3	2	3	2	2	3	2	2	2	2	2	1	2	2	2
CO4	2	3	2	2	3	2	2	2	2	2	1	2	2	2
CO5	2	3	3	2	3	2	2	2	2	2	1	2	2	2
Avg.	2	2	2	2	2	2	2	2	2	2	1	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2420	WASTE WATER TREATMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process.					

Unit-I	CHEMICAL UNIT PROCESSES	(9)
Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water; inorganic, Organic and heavy metal constituents.		
Unit-II	CHEMICAL UNIT PROCESSES	(9)
Role of unit processes in waste water treatment- Principles of Chemical treatment – Coagulation - flocculation– Precipitation–flotation – solidification and stabilization –disinfection		
Unit-III	BIOLOGICAL TREATMENT	(9)
Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment - selection of process-reactors-batch-continuous type.		
Unit-IV	TREATMENT METHODS	(9)
Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters- RBC-Moving Bed Reactors- fluidized bed reactors, aerated lagoons, waste stabilization ponds- Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal		
Unit-V	ADVANCED WASTE WATER TREATMENT	(9)
Technologies used in advanced treatment – Classification of technologies- Removal of Colloids and suspended particles– Membrane Filtration – Ion Exchange – Advanced oxidation process – Zero liquid Discharge. - Software Applications		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Waste water Engineering Treatment and Reuse: McGraw Hill, G. Tchobanoglous, FI Biston, 2002.
2	Industrial Waste Water Management Treatment and Disposal by Waste Water McGraw Hill III Edition 2008.
3	S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.

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4	4 .C.S. Rao, Environmental Pollution Control Engineering, New Age International, 2007
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REFERENCES:

1	Casey, T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wiley & Sons, 2006.
2	Metcalf & Eddy, Inc. Wastewater Engineering - Treatment, Disposal, and Reuse, Fourth Edition, Tata McGraw-Hill, 1995. 14
3	Cheremisinoff, P.N., Handbook of water and wastewater technologies, BH Publications, 2002.
4	Sincero, P.A., and Sincero, A.G., Physical Chemical treatment of water and wastewater, IWA Publications, 2002.
5	Spellman, R.F., Handbook of water and wastewater treatment plant operations, CRC Press/Taylor & Francis Publications, 2009.

COURSE OUTCOMES:

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

CO1:	Understand the Physical and chemical Characteristics of wastewater and their measurement.
CO2:	Understand the various pollutant treatment techniques.
CO3:	Understand the concepts using biological treatment methods.
CO4:	Analyze the reactors used for various treatment techniques
CO5:	Understand the membrane based electrochemical process for pollutant treatment.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	1	2	2	2	2	2	2	2	2	2	1	1
CO2	2	2	1	2	2	2	2	2	2	2	2	2	2	1
CO3	2	2	2	2	3	2	2	2	2	2	2	2	2	1
CO4	2	2	2	2	3	2	2	2	2	2	2	2	2	1
CO5	2	3	2	2	3	2	2	2	2	2	2	2	2	1
Avg.	2	2	2	2	3	2	2	2	2	2	2	2	2	1

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2421	SOLID WASTE MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.					

Unit-I	SOURCES AND CHARACTERISTICS	(9)
Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics - Elements of integrated solid waste management – Requirements and salient features of Solid waste management rules (2016) -- Role of public and NGO"s- Public Private participation – Elements of Municipal Solid Waste Management Plan.		
Unit-II	SOURCE REDUCTION, WASTE STORAGE AND RECYCLING	(9)
Waste Management Hierarchy - Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – case studies under Indian conditions – Recycling of Plastics and Construction/Demolition wastes.		
Unit-III	COLLECTION AND TRANSFER OF WASTES	(9)
Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance; options under Indian conditions – Field problems- solving.		
Unit-IV	PROCESSING OF WASTES	(9)
Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and bio meth nation; Thermal processing options – case studies under Indian conditions.		
Unit-V	WASTE DISPOSAL	(9)
Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	William A. Worrell, P. Aarne Vesilind (2012) Solid Waste Engineering, Cengage Learning, 2012.
2	John Pitchel (2014), Waste Management Practices-Municipal, Hazardous and industrial – CRC Press, Taylor and Francis, New York.

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3	Tchobanoglous, G., Theisen, H. M., and Eliassen, R. "Solid. Wastes: Engineering Principles and Management Issues". McGraw Hill, New York, 1993.
4	Vesilind, P.A. and Rimer, A.E., "Unit Operations in Resource Recovery Engineering", Prentice Hall, Inc., 1981

REFERENCES:

1	Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of UrbanDevelopment, New Delhi, 2000.
2	Manser A.G.R. and Keeling A.A., " Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996.

COURSE OUTCOMES:

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

CO1:	State solid waste characteristics and its sources.
CO2:	Identify and analyze different methods of treatment of solid waste.
CO3:	Illustrate Industrial practices in solid waste management.
CO4:	Discuss the significance of recycling reuse and reclamation of solid wastes.
CO5:	Assess the relationships between environmental guidelines, human activities and quality of impacted soil, water and air.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	2	2	2	2	1	2	2	1	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2	1	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	1	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2	1	2
CO5	2	1	2	2	2	2	2	2	2	2	2	2	1	2
Avg.	2	1	2	2	2	2	2	2	2	2	2	1	1	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2422	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects					

Unit-I	INTRODUCTION	(9)
Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework.		
Unit-II	ENVIRONMENTAL ASSESSMENT	(9)
Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.		
Unit-III	ENVIRONMENTAL MANAGEMENT PLAN	(9)
Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Public Hearing-Environmental Clearance		
Unit-IV	SOCIO ECONOMIC ASSESSMENT	(9)
Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis		
Unit-V	MONITORING STUDIES AND APPLICATIONS	(9)
Environmental monitoring - guidelines - policies - planning of monitoring programmes; Environmental Management Plan- Post project audit ; Case studies of EIA of developmental projects in Food, Fertilizer and Petrochemical industry.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Canter, L. W., Environmental Impact Assessment, McGraw Hill, New York, 1996.
2	Petts, J., Handbook of Environmental Impact Assessment Vol. I and II, Blackwell Science, London, 2009.
3	Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
4	Anjaneyulu, Y., and Manickam, V., Environmental Impact Assessment, Methodologies, 2nd Edition, BS Publications, 2007

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REFERENCES:

1	Becker H. A., Frank Vanclay, "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2	Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3	Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4	Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.
5	Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
6	Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
7	Morris, P., and Therivel, R., Methods of Environmental Impact Assessment, 3rd Edition, Taylor & Francis, 2009.

COURSE OUTCOMES:

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

CO1:	Understand the concept of environmental Impact assessment
CO2:	Know various components and assessment techniques of EIA.
CO3:	Understand Environmental management plan
CO4:	Understand socio economic assessment plans
CO5:	Gain knowledge about EIA monitoring studies through various industrial exposure

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	2	2	2	2	2	2	2	2	2
CO2	2	1	2	2	1	2	2	2	2	2	2	2	2	2
CO3	2	1	2	2	1	2	2	2	2	2	2	2	2	2
CO4	2	1	2	2	1	2	2	2	2	2	2	2	2	2
CO5	2	1	2	2	1	2	2	2	2	2	2	2	2	2
Avg.	2	1	1	2	1	2	2	2	2	2	2	2	2	2

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2423	PROCESS SAFETY MANAGEMENT	L	T	P	C	100
		3	0	0	3	

Unit-I	PROCESS SAFETY INFORMATION	(9)
Safety vs Process Safety, Importance of Process Safety, Elements of Process safety - Overview ; Process Safety Information (PSI) – Importance of Process Safety Information , Types of PSI, Collection of PSI, familiarization of formats for capturing PSI, Challenges		
Unit-II	SAFETY PROGRAMMES AND PROCEDURES	(9)
Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling-Implementation of safety procedures – periodic inspection and replacement; Standard Operating Procedure – Overview and its importance, how to write effective operating procedure, Types of Procedures, Standard operating conditions and consequence of deviation; Emergency planning		
Unit-III	ACCIDENT ANALYSIS	(9)
Accidents – identification and prevention, promotion of industrial safety. Process Safety Incident reporting and Investigation – Element overview, reporting and its importance; Process safety incident classification, Root cause analysis, making recommendations ; Past accident analysis- Fixborough-Mexico- Chernobyl nuclear disaster-Bhopal gas analysis- process safety indicators		
Unit-IV	PROCESS HAZARD ANALYSIS	(9)
Hazard identification- safety audits, checklist, what if analysis, vulnerability models- event tree analysis-fault tree analysis. Asset Integrity Process Hazard Analysis - Introduction to PHA, Overview of PHA Techniques, Selection of PHA techniques Implementation of recommendation – Key Aspects. Cyclic PHA /Revalidation; Review of PHA methodology (Prerequisites, Team Composition and their attributes)		
Unit-V	SAFETY MANAGEMENT	(9)
Employee Participation – Overview, Benefits of Employee participation, Various modes of engaging workforce in PSM, Challenges; Management of Change – Types of Changes, Managing Changes in PSM Perspective, Framework, evaluating changes-Institutionalizing and integrating safety into the PSM fabric, 5 tier approach, selection, training, Performance monitoring; Case studies – Process safety management in industry – present and futuristic approach.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
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2	Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.
3	Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
4	Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004

REFERENCES:

1	Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.
2	Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGrawHill Book Co., 1980.
3	Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

COURSE OUTCOMES:

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

CO1:	Understand the chemical process safety, safety codes
CO2:	Safe handling of chemicals and plant inspection
CO3:	Learn the different analysis to overcome the accidents in process industry
CO4:	Understand the hazard analysis in process industry
CO5:	Knowledge on safety management in different process industry

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	2	2	2	1	2	2	2	1	2
CO2	2	-	2	2	-	2	2	2	1	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	2	2	2	2	2
CO5	2	2	3	2	3	2	2	2	2	2	2	2	2	2
Avg.	2	1	1	1	2	2	2	2	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2424	RISK AND HAZOP ANALYSIS	L	T	P	C	100
		3	0	0	3	

Unit-I	RISK ANALYSIS	(9)
Risk analysis introduction, quantitative risk assessment, rapid risk analysis –comprehensive risk analysis – identification, evaluation and control of risk		
Unit-II	RISK ASSESSMENT	(9)
Risk assessment – introduction and available methodologies, Risk assessment steps- Quantitative risk analysis-event tree, fault tree, consequence analysis and layer of protection analysis- Bow tie analysis -		
Unit-III	EMERGENCY PLANNING	(9)
Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies- marketing terminal, gas processing complex ; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.		
Unit-IV	HAZARD	(9)
Hazard - Hazard identification – methods: Process Hazard Analysis - Introduction to PHA, Overview of PHA Techniques, Selection of PHA techniques Implementation of recommendation – Key Aspects. Cyclic PHA /Revalidation; Review of PHA methodology (Prerequisites, Team Composition and their attributes)		
Unit-V	HAZOP	(9)
Introduction to HAZOP-Significance of HAZOP -HAZOP procedure –HAZOP Analysis -Computer usage in HAZOP- softwares employed - Limitations of HAZOP – case studies.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2	Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“, Wiley Interscience, 1965.
3	Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
4	Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004

REFERENCES:



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1	Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.
2	Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGrawHill Book Co., 1980.
3	Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

COURSE OUTCOMES:

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

CO1:	Understand the knowledge of types of risks arising in working environment
CO2:	Perform Risk Assurance and Assessment
CO3:	Design Risk management systems and planning
CO4:	Analyze the effect of process hazard
CO5:	Hazop and its consequences and to create hazard free working premises

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	2	2	2	1	1	1	2	-
CO2	2	1	2	2	2	1	2	2	2	1	2	1	2	-
CO3	2	2	3	3	2	3	2	2	2	1	2	2	2	2
CO4	2	2	3	3	2	2	2	2	2	1	2	2	2	2
CO5	2	2	3	3	2	3	2	2	2	1	2	2	2	2
Avg.	2	2	2	2	2	2	2	2	2	1	2	2	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy



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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2425	COMPUTATIONAL TECHNIQUES	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to Understand the numerical methods for linear algebraic equations. •To enable students to Identify numerical methods for non linear algebraic equations •To enable students to Identify different methods for interpolation and numerical integration •To enable students learn knowledge on the numerical methods for ordinary differential equations					

Unit-I	NUMERICAL METHODS FOR SYSTEM OF LINEAR ALGEBRAIC EQUATIONS	(9)
Gauss elimination, LU decomposition, matrix inversion, Tri-diagonal matrix algorithm, Gauss-Seidel method, Chemical Engineering problems involving solution of linear algebraic equations.		
Unit-II	NUMERICAL METHODS FOR NON LINEAR ALGEBRAIC EQUATIONS	(9)
Introduction, Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, System of Non-linear Equations, Chemical Engineering problems involving solution of non-linear equations		
Unit-III	INTERPOLATION AND NUMERICAL INTEGRATION	(9)
Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression, Numerical integration: Trapezoidal rule, Simpson's rule, integration with unequal segments, Chemical engineering problems involving numerical differentiation and integration.		
Unit-IV	NUMERICAL METHODS FOR ODES	(9)
Euler method – explicit and implicit, Runge-Kutta method – 2nd and 4th order, Boundary value problems – shooting method, Chemical engineering problems involving single and system of ODEs.		
Unit-V	NUMERICAL METHODS FOR PDES	(9)
Introduction to Partial Differential Equations: Characterization of PDEs, parabolic, elliptic and first order hyperbolic equations, explicit and implicit methods, Chemical engineering problems involving the three types of PDEs.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Chapra. S. C. & Canale, R. P., "Numerical Methods for Engineers", Eighth Edition, McGraw Hill, 2021.
2	Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012.
3	Ahuja, P., "Introduction to Numerical methods in Chemical Engineering" 2nd Edition, PHI learning Private Ltd, 2019.

REFERENCES:

1	R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.
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COURSE OUTCOMES:

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

CO1:	Understand the numerical methods for linear algebraic equations.
CO2:	Identify numerical methods for non linear algebraic equations.
CO3:	Identify different methods for interpolation and numerical integration.
CO4:	knowledge on the numerical methods for ordinary differential equations.
CO5:	Understand the basic methods for partial differential equations.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	1	-	1	2	2	2	2	2	1
CO2	2	2	1	2	1	1	-	1	2	2	2	2	2	-
CO3	2	2	1	2	1	1	-	1	2	2	2	2	2	1
CO4	2	2	1	2	1	1	-	1	2	2	2	2	2	1
CO5	2	2	1	2	1	1	-	1	2	2	2	2	2	1
Avg.	2	2	1	2	1	1	-	1	2	2	2	2	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2426	OPTIMIZATION OF CHEMICAL PROCESSES	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to be familiar on the basic problem formulation and optimization. •To enable students to Understand mathematical characteristics of Linear programming •To enable students to Learn computational solution techniques for nonlinear unconstrained optimization. •To enable students to Understand various techniques used in constrained optimization					

Unit-I	PROBLEM FORMULATION & CLASSIFICATION	(9)
Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods		
Unit-II	LINEAR PROGRAMMING	(9)
Review on basic concepts of LP formulations; Simplex methods; Big-M method, two phase method and Duality in linear programming.		
Unit-III	NON-LINEAR PROGRAMMING	(9)
The Lagrange multiplier method, Integer, quadratic, geometric and dynamic programming.		
Unit-IV	NUMERICAL METHODS	(9)
Unimodal functions; Newton, quasi Newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; Powell's technique; indirect methods; gradient and conjugate gradient methods; secant method		
Unit-V	APPLICATIONS	(9)
Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Edgar T.F., Himmelblau D.M., Lasdon, L.S., Optimization of Chemical Processes, Second Edition, McGraw-Hill, New York, 2001.

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2	Rao, S. S., Engineering Optimization: Theory and Practice, Fifth Edition, Wiley, New York, 2019.
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REFERENCES:

1	Reklaitis G.V., Ravindran A., Ragsdell, K.M., Engineering Optimization, Wiley, New York, 1980.
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COURSE OUTCOMES:

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

CO1:	Be familiar on the basic problem formulation and optimization.
CO2:	Understand mathematical characteristics of Linear programming
CO3:	Learn computational solution techniques for nonlinear unconstrained optimization.
CO4:	Understand various techniques used in constrained optimization
CO5:	Apply the optimal and dynamic optimization.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	1	1	1	2	2	2	2	2
CO2	1	2	2	2	2	1	-	1	2	2	2	2	2	2
CO3	1	2	2	2	2	1	-	1	2	2	2	2	2	2
CO4	2	2	2	2	2	1	-	1	2	2	2	2	2	2
CO5	2	2	2	2	2	1	-	1	2	2	2	2	2	2
Avg.	1	2	2	2	2	1	-	1	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2427	PROCESS MODELING AND SIMULATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics •To enable students to Understand Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation methods •To enable students to Create the mathematical models for different unit operations equipments •To enable students to Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems					

Unit-I	INTRODUCTION AND FIRST PRINCIPLES	(9)
Definition, Uses of Mathematical Models - Principles of formulation, Classification of Process Models, Fundamental laws: Total Continuity equation- Macroscopic and Microscopic Examples, Component Continuity Equation – Macroscopic and Microscopic Examples, Energy equation, Equations of motion, Transport equations, Equations of State, Equilibrium and Chemical Kinetics. Simple Examples.		
Unit-II	LUMPED SYSTEMS	(9)
Simple Hydraulic Tank, Variable flow hydraulic tank, Enclosed tank, Adiabatic compression in gas space, Mixing vessel, Mixing with reaction, Reversible reaction, Steam jacketed vessel, Continuous flow boiling system.		
Unit-III	STAGED OPERATIONS AND DISTRIBUTED SYSTEMS	(9)
Staged Operations: Counter current extraction, Distillation columns - Binary distillation. Distributed systems: Counter current Heat exchanger, Membrane separation process, tubular reactor and evaporators.		
Unit-IV	FITTING MODEL TO DATA	(9)
Fitting Linear Model, Multi-Linear Models, Matrix representation of Multi Linear Model, Fitting Quadratic Model, Cubic Model and Polynomial model using Regression, Power Law models. Performance Criteria to check quality of model, Co-efficient of Determination (R^2)		
Unit-V	SIMULATION OF BASIC MODELS	(9)
MATLAB/Simulink - Introduction, Basic components, Operational Blocks, Examples - Gravity flow tank, Three CSTR's in series, Numerical solution of model using RK4, Euler's explicit and implicit techniques, Introduction to ODE 45 solver, Dynamic simulation of simple tank, variable flow tank, enclosed tank with isothermal compression, mixing vessel, mixing vessel with reaction using ODE 45 solver.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Bequette, B. W., Process Dynamics: Modeling, Analysis, and Simulation. Prentice-Hall, 2002.
2	Babu, B V., Process Plant Simulation, Oxford University Press, 2004.
3	Jana, A. K., Chemical Process Modeling and Computer Simulation, Second Edition, Prentice Hall India Pvt. Ltd, 2011.

REFERENCES:

1	Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill, International Student Edition, Second Edition, 1996.
2	Ramirez, W. D., Computational Methods for Process Simulation, Second Edition, Elsevier Science, 1997.

COURSE OUTCOMES:

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

CO1:	Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics
CO2:	Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation methods
CO3:	Create the mathematical models for different unit operations equipments
CO4:	Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems
CO5:	Apply relevant solution methods for the mathematical models with relevant initial and/or boundary conditions

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	1	2	1	1	2	2	2	1
CO2	2	2	2	2	2	1	1	2	1	1	2	2	2	1
CO3	2	2	2	2	2	1	1	2	1	1	2	2	2	1
CO4	2	2	2	2	2	1	1	2	1	1	2	2	2	1
CO5	2	2	2	2	2	1	1	2	1	1	2	2	2	1
Avg.	2	2	2	2	2	1	1	2	1	1	2	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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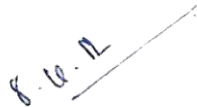


Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2428	PINCH ANALYSIS AND HEAT EXCHANGER NETWORK DESIGN	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to Understand the pinch concept and process thermodynamics •To enable students to Identify minimum energy targets •To enable students to Understand the knowledge of diagrams and energy cost target •To enable students to Identify different choices and constraint during heat exchange networking					

Unit-I	INTRODUCTION	(9)
Pinch analysis, process synthesis, pinch point, composite curves, energy targeting: problem table algorithm, shifted composite curve, capital cost, total cost targeting, process modification.		
Unit-II	TARGETING	(9)
Heat exchanger networks, energy targeting, area targeting, unit targeting, shell targeting, cost targeting, super targeting, and continuous targeting.		
Unit-III	PINCH ANALYSIS	(9)
Identification of streams, temperature, enthalpy diagram, minimum temperature difference, construction of composite curves, energy cost target, optimum target, design of heat exchanger network.		
Unit-IV	PINCH DESIGN AND OPTIMIZATION	(9)
Networks for maximum energy recovery, Pinch design method, flexibility criteria of the pinch, optimization of heat exchanger network, optimality for a minimum area network, Sensitivity analysis.		
Unit-V	ENERGY AND RESOURCE ANALYSIS OF VARIOUS PROCESSES	(9)
Batch process, flexible process, distillation process, evaporation process, reaction process, process using mass separating agent, heat pipes and heat pumps.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Kemp, I. C., Pinch Analysis and Process Integration, Second edition, Elsevier, 2006.
2	Shenoy, V. U., Heat Exchanger network synthesis, Gulf Publishing, 1995.


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REFERENCES:

1	Douglas, J. M., Conceptual Design of Chemical Process, McGraw Hill, 1988.
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COURSE OUTCOMES:

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

CO1:	Understand the pinch concept and process thermodynamics
CO2:	Identify minimum energy targets
CO3:	Understand the knowledge of diagrams and energy cost target
CO4:	Identify different choices and constraint during heat exchange networking
CO5:	Apply strategies for retrofitting existing process plant, integration of energy demands of multiple processes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	2	2	2	1	2	2	1	1	2
CO2	2	1	2	2	2	2	2	2	2	1	2	2	2	2
CO3	2	1	3	2	2	2	2	2	2	2	2	2	2	2
CO4	2	1	3	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	3	2	2	2	2	2	2	2	2	2	1	2
Avg.	2	1	2	2	2	2	2	2	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2429	CHEMICAL PROCESS FLOW SHEETING	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to understand the basic concept in preparation of flowsheet •To enable students to knowledge on preparing networks •To enable students to understand different approach in flowsheeting •To enable students to earn the flowsheet preparation by equation solving methods					

Unit-I	FLWSHEETING	(6)
Introduction, symbols, flowsheet presentation with examples, manual flowsheet calculation, flowsheeting approaches.		
Unit-II	DECOMPOSITION OF NETWORKS	(11)
Partitioning and tearing a flowsheet, tearing algorithms based on signal flow graph, algorithms based on reduced graph, comparing various tearing algorithms		
Unit-III	SEQUENTIAL MODULAR APPROACH TO FLOW SHEETING	(11)
Principle of method, convergence of flowsheet using different methods - Newton's method, direct substitution, Wegstein's method, dominant Eigenvalue method, quasi Newton method, criteria for acceleration		
Unit-IV	FLWSHEETING BY EQUATION SOLVING METHODS	(9)
Precedence ordering, disjoining, tearing a system of equations, SWS algorithm, maintaining sparsity, solution of system of equations using Newton's method		
Unit-V	CASE STUDIES	(8)
Simulation of process flowsheets involving mass recycle, energy recycle, tear stream and design specification, demonstration of open source flowsheeting software.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Babu, B V., Process Plant Simulation, Oxford University Press, 2004

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REFERENCES:

1	Douglas, J. M., Conceptual Design of Chemical Process, McGraw Hill, 1988.
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COURSE OUTCOMES:

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

CO1:	understand the basic concept in preparation of flowsheet
CO2:	knowledge on preparing networks
CO3:	understand different approach in flowsheeting
CO4:	to learn the flowsheet preparation by equation solving methods
CO5:	Evaluate the case studies using flowsheeting software.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	1	1	2	1	2	2	2	-	2
CO2	2	-	-	-	2	1	1	1	2	1	2	2	2	2
CO3	2	1	2	1	2	1	1	1	2	2	2	2	2	2
CO4	2	2	2	1	2	1	1	1	2	2	2	2	2	2
CO5	2	2	2	2	2	1	1	1	2	2	2	2	2	2
Avg.	2	1	1	1	2	1	1	1	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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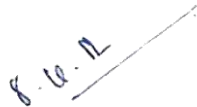
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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2430	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To enable the students to Understand the basics of CFD and governing equations for conservation of mass momentum and energy •To enable students to Understand mathematical characteristics of partial differential equations •To enable students to learn computational solution techniques for time integration of ordinary differential equations •To enable students to gain knowledge in various discretization techniques used in CFD					

Unit-I	GOVERNING EQUATIONS	(9)
Governing equations of fluid flow and heat transfer - Navier-Stokes equations for a Newtonian fluid, Classification of physical behaviour, Classification of fluid flow equations, Auxiliary conditions for viscous fluid flow equations.		
Unit-II	TURBULENCE AND ITS MODELLING	(9)
Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, free turbulent flows, flat plate boundary layer and pipe flow, Turbulence models, mixing length model, The k-omega model, Reynolds stress equation model, algebraic stress equation model.		
Unit-III	FINITE VOLUME METHOD FOR DIFFUSION PROBLEMS	(9)
Introduction to finite volume method, one-dimensional steady state diffusion, two-dimensional diffusion, discretised equations for diffusion problems.		
Unit-IV	FINITE VOLUME METHOD FOR CONVECTION-DIFFUSION PROBLEMS	(9)
Steady one-dimensional convection and diffusion, the central differencing scheme, properties of discretisation schemes - conservativeness, boundedness, transportiveness, Assessment of the central differencing scheme for convection-diffusion problems, The upwind differencing scheme, hybrid differencing scheme, power-law scheme, higher order differencing schemes, quadratic upwind differencing scheme.		
Unit-V	FINITE VOLUME METHOD FOR UNSTEADY FLOWS	(9)
One-dimensional unsteady heat conduction, transient convection-diffusion equation, solution procedure for unsteady flow calculations. Implementation of inlet, outlet and wall boundary conditions, constant pressure boundary condition.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Versteeg H. K. and Malalasekera, W., An introduction to computational fluid dynamics: the finite volume method, Second edition, Pearson, 2008.
2	Anderson, J. D. Computational fluid dynamics: The Basics with Applications, McGraw-Hill, 1995.

REFERENCES:

1	Douglas, J. M., Conceptual Design of Chemical Process, McGraw Hill, 1988.
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COURSE OUTCOMES:

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

CO1:	Understand the basics of CFD and governing equations for conservation of mass momentum and energy
CO2:	Understand mathematical characteristics of partial differential equations
CO3:	learn computational solution techniques for time integration of ordinary differential equations
CO4:	gain knowledge in various discretization techniques used in CFD
CO5:	Understand flow field computation techniques for steady and unsteady flows

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	1	2	2	1	2	2	2	1
CO2	2	2	2	2	2	2	1	2	2	1	2	2	2	1
CO3	2	2	2	2	2	2	1	2	2	1	2	2	2	1
CO4	2	2	2	2	2	2	1	2	2	1	2	2	2	1
CO5	2	2	2	2	2	2	1	2	2	1	2	2	2	1
Avg.	2	2	2	2	2	2	1	2	2	1	2	2	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2431	CHEMICAL PLANT DESIGN	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the intricacies in equipment sizing and selection amongst options therein - To leverage lessons learnt in designing chemical process unit with safety as paramount					

Unit-I	ROTARY EQUIPMENT	(9)
Pumps: Various types: Centrifugal, Reciprocating & Other Positive displacement types – Plunger, Piston, Diaphragm, Gear, Screw, Lobe, Vane, etc.; Compressors: Various types: Axial, Centrifugal, Reciprocating, and other positive displacement type such as Rotary Screw, Scroll, etc. Further, compressors are classified into two namely Oil free and Oil flooded lubricated; Fans: Various types: Axial fans (including Propeller, Tube-axial, and Vane-axial) and Centrifugal fans. Further fans are classified as Induced draft and Forced draft types; Steam Turbines: : Various types: Back Pressure and Condensing Types with and without extraction, Impulse & Reaction types; Gas Turbines : Various types: Turbojet, Turboprop, Turbofan and Turboshaft Engines; Motor : Various types: AC motors (Synchronous & Asynchronous motors), DC motors (brushed and brushless), Variable Frequency and Variable Speed motors and Special purpose motors, Generator: Various types: AC and DC generator; Other Special Equipment: Various types: Power Recovery Turbines, Heat Pumps, Ejector pump, NASH vacuum pump Case Studies – From Industries on operations and maintenance aspects viz. Trouble shooting, Energy improvement, Capacity augmentation, Design tips, Equipment safety, Catastrophic incidents, etc.		
Unit-II	STATIC EQUIPMENT - HEAT TRANSFER EQUIPMENT	(9)
Heat Exchangers– Shell and Tube, Double Pipe, Plate & Frame type, Tube in tube Scraped surface, and Fin tube, Coolers, Condensers, Fin Fan Coolers; Fired Heaters & Boilers– With or without air preheaters, Balanced draft or simply natural draft or even only forced draft, With and without waste heat generation, Refrigeration & Air Conditioning– HVAC (Heating, Ventilation, and Air Conditioning); Miscellaneous – Chilled water system with vapour compression refrigeration, Ejector refrigeration system, direct contact heat exchanger (such as cooling towers, Jet condensers, direct contact feed), Incinerator. Case Studies – From Industries on operations and maintenance aspects viz. Fouling control, Pinch study for energy recovery, Capacity creep, Design tips, Equipment safety, Catastrophic incidents, etc.		
Unit-III	STATIC EQUIPMENT - MASS TRANSFER	(9)

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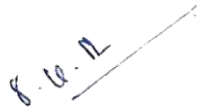
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Mass Transfer Operations: Multi Component Distillation columns, Extractive distillation, Reactive Distillation, Azeotropic distillation, Divided wall columns, Dryers, Adsorption Isotherm, Pressure Swing Adsorption, Importance of recycles and Optimization needs, Absorption processes & operating variables, Liquid – Liquid Solvent Extraction ; Humidification & dehumidification, Evaporation, Precipitation, Crystallizers, Membrane filtration; Reactors– CSTR, Slurry phase reactor, Tubular, Trickle Bed Reactor, etc., thermodynamically controlled reaction and kinetically controlled reaction, Reaction Kinetics, Importance of Reactor internals. Case Studies – From industries across life cycle such as Trouble shooting, enhance conversion & selectivity, IoT use, Debottlenecking, Design tips, Safety Incidents “Fit - For Purpose” Assessment, etc.

Unit-IV	EQUIPMENT ANCILLARIES	(9)
Special equipment– Static Mixer, Agitators, Jet Mixing, Ejectors, Eductors, Structured Packing, Grid Packing and Random Packing, Demisters, Vortex Breaker, Calming Baffles, Schoepentoeter, Vapour horn device, Cyclone separators; Package units – Inert gas generators, Feed stream filters (Mechanical, Chemical), Scrubbers, Spray Nozzles, Guard beds, Flare stack, Ground Flare, Flame arrestors, Strainers, Spring supports, Expansion joints, Electrostatic Precipitators; Steam Traps – Thermodynamic, Inverted Bucket type, Thermostatic – Float, Bimetallic type, etc., Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-V	STATIC EQUIPMENT - PRESSURE VESSELS, INTERNALS &SAFETY VALVES	(9)
Pressure Vessels – Vertical / Horizontal, Knock Out Drums, Steam and Blow down drum, Cold & Hot Separators, Surge drum, Deaerators, Water Seal Pot, Molecular seals, Shock Absorbers, Pressure snubber, Silencer, Slug Catcher, Desalter, Coke drum; Vessel & Columns – associated structural accessories such as Platforms, Ladders, Staircase etc. Internals –Column internals such as Trays (Sieve, Valve, Bubble Cap, Baffle, Dual flow, Multi down comer, Chimney tray etc.), Packings (structured, grid, random, etc.), Packed tower internals – Bed support plates, Liquid distributors, Bed limiters etc.; Mist eliminators, Demisters, Coalescing pads, Vortex breakers etc. Safety Valves: Normal, balanced bellows, pilot operated, etc., Rupture Discs, and Design codes governing Safety valve design, Case Studies– From industrial operations & maintenance activities–ASME codes, Trouble shooting, Efficiency tracking, Use of IoT, Debottlenecking, and Design tips, Safety & Environmental Incidents, etc.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Chemical Engineering Handbook - Robert H. Perry; Don W. Green and James O. Maloney
2	Heat Transfer – D.Q. Kern
3	Mass Transfer Operations – Robert E. Treybal
4	Principles of Mass Transfer and separation Processes – BK Dutta


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5	Fluid Mechanics, Heat Transfer, and Mass Transfer (Chemical Engineering Practice) – KSN Raju
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REFERENCES:

1	Applied Process Design for Chemical and Petrochemical Plants – Ernest E. Ludwig
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COURSE OUTCOMES:

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

CO1:	understand the basic on designing chemical process unit for rotary equipment
CO2:	learn the operations of boilers, heat exchangers, refrigeration and air conditioners.
CO3:	knowledge on operations of reactors, humidifiers and mass transfer operations
CO4:	learn the different types of equipments in process industries
CO5:	understand the knowledge on usage of different valves such as pressure, safety and internal.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	-	2	1	2	2	2	2	1
CO2	2	2	2	2	2	1	-	2	1	2	2	2	2	1
CO3	2	2	2	2	2	1	-	2	1	2	2	2	2	1
CO4	2	2	2	2	2	1	-	2	1	2	2	2	2	1
CO5	2	2	2	2	2	1	-	2	2	2	2	2	2	1
Avg.	2	2	2	2	2	1	-	2	1	2	2	2	2	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2432	PLANT LAYOUT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the importance of plant layout in mitigating risk on people, plant, planet - To apply knowledge in placing equipment for ease of operability & maintainability					

Unit-I	STANDARDS FOR AREA CLASSIFICATION	(9)
Standards for area classification–Electrical Area classifications, OSHA (Occupational Safety and Health Administration) regulations, National Fire Protection Association (NFPA), Petroleum Hazards Classification, IP15 Petroleum classification based on flash point, OISD standards (Oil Industry Safety Directorate), API Codes (American Petroleum Institute), PESO (Petroleum and Explosives Safety Organization) guidelines, Investigations Reports & Best practices data Chemical Safety Board, USA Case Studies – From Industries on Lessons from Incidents from Environmental Protection Agency (EPA), Safety & Environmental Incidents, etc.		
Unit-II	INTER UNIT DISTANCES	(9)
Distance between plants, substation, centralized control room, utilities sections / captive power plants; Inter-distance between adjacent Columns, Storage tanks, Tank dykes; Flare stack location (based on Prevailing up-wind direction), Design to keep it smokeless, Sterile zone/area – Governing API /OISD Standards, Field cabins. Access to firefighting facilities, Fire tank capacity, Foam need assessment, Design to tackle simultaneous fire incidents, Protection of fire network and ensuring availability on demand, Risk evaluation(arising from inventory of inflammable liquid, potential formation of explosive mixture, operation above auto-ignition temperature, toxic release, etc.) based on credible scenario;3D models used in equipment & piping isometric, Maintenance accessibility, Safe work place specially at elevated platform, Ease of emergency evacuation; Bow Tie Analysis to mitigate risk right at design stage, Blast proof design of control room, Minimize employee occupancy at a given time in risk zone. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-III	STORAGE TANKS	(9)

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Storage Tanks – Fixed or Floating roof, Mounded Bullet tanks, Cryogenic storage tanks & their special design requirements, Special designs along with breather systems, Lightning arrestors, Earth pits, other appurtenances –Manways for roofs or tank sidewalls, Catwalks, Roof vents, Roof hatches, Nozzles, Roofs (flat-style, knuckle-style, or pitched), Aluminium geodesic domes, Ladders, etc. Comfort factors Vs Inventory carrying cost, Safe operation of floating roof travel, breather sizing, steam coils design, rainwater drains, dyke capacity, inter tank distance based on product hazard classification, tank inspection schedule, ease of cleaning, confined place entry, water spray and other firefighting feature, fugitive emission control, etc. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Water traps and roof collapse, safe filling height, Design tips, Safety & Environmental Incidents, etc.

Unit-IV	AT RISK SYSTEMS AND EQUIPMENT	(9)
At-risk systems and equipment: Fuel gas systems, Fuel oil network, Hydrogen gas for generator cooling in power plants; Plant battery systems, Ammonia systems, Solid handling of coal and coke dust, Sulphur yard, Toxic gas loss of containment, etc, MSDS of every stream being handled / processed, Spent catalyst safe disposal ;Safe at Risk Assessment: Overall risk assessment using credible scenario along with preventive measures & systems to be in place to eliminate / minimize loss of containment. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Process Control, Early event detection, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-V	BASIC ENGINEERING DESIGN PACKAGE	(9)
Basic Engineering Design Package (BEDP): First document to be prepared and approved between Process Engineering Team and Owner's representative. It shall cover not limited to – Site Conditions (weather, wind rose, seismic activity, water table, etc.); System of measurement (in 195 FPS or MKS for flow of gas / liquid / steam, temperature, pressure, heat duty, inferential properties, etc.), Design considerations and margins, Design philosophies such as Operating & Control philosophy, Vent & Drain philosophy, Isolation philosophy, sparing philosophy etc. Raw material details (Capacity, conditions, logistics including receipt modes & storage criteria) Product offtake plans and modes of distribution, environmental norms, Levels of power & utilities that would be available for safe and hassle free operations ; Green belt cover, use of renewables, zero liquid discharge, maximum air cooling / condensing, storm water channel considerations, rain water harvesting ; Flare gas recovery, flight path and tall structures in industry premises, MIQA (mechanical integrity and quality assurance) considerations, equipment designed life ; Feed definition / variability / flexibility, product mix& swings, product quality, custody transfer design basis, turnaround plans ; Energy & loss targets and best in class design considerations, criteria for smooth and faster start-up, onstream factor, spinning margin, applicable codes, built in features for continual improvement, advanced process control and other s/w deployment for SCM (Supply Chain Mgt) and O&M (Operation and Maintenance) excellence. Case Studies – Lessons learnt from Industries viz. examples of regret investment, deviations from original design & impact thereof, market forces & design adaptability, challenges in product quality, etc.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Chemical Engineering Design Principles, Practice and Economics of Plant and Process Design - GAVIN TOWLER and RAY SINNOTT
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REFERENCES:

1	OISD Guideline on Plant Layout - OISD-STD-118
2	OSHA Guidelines on Plant Layout
3	API Guidelines on Plant layout

COURSE OUTCOMES:

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

CO1:	understand the importance of plant layout in mitigating risk on people, plant, planet
CO2:	understand the knowledge in placing equipment for ease of operability & maintainability
CO3:	understand the storage tanks operation and usage at safety level
CO4:	knowledge on usage of equipment at safety levels and their risk assessment
CO5:	understand the basic engineering design package

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	1	1	1	1	2	2	2	2	2
CO2	2	1	2	2	2	1	1	1	1	2	2	2	2	1
CO3	2	1	2	2	2	1	1	1	1	1	2	2	2	2
CO4	2	1	1	2	2	1	1	1	1	2	2	2	2	1
CO5	2	1	2	2	2	1	1	1	1	1	2	2	2	2
Avg.	2	1	2	2	2	1	1	1	1	2	2	2	2	2

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2433	DESIGN SAFETY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the process safety systems both to prevent incident & to minimize loss - To apply the principles ‘safe at risk’ to assess likely unsafe conditions in unit operation					

Unit-I	SAFETY SYSTEMS	(9)
Safety systems: Deployment of sensors (Toxic, HC and Thermal) at critical locations, Fire network including elevated fire monitors, Egress system, Escape route and Assembly point, Water curtain, eye wash requirement, Clean and cooler water supply ;Dovetail Early Event Detections system to forecast and forewarn on 'unsafe' conditions emerging in process units, Cause & Effect diagram, Alarm rationalization, Partial or Total Plant Trips review; Setting up IOW (Integrity Operating Window), Utility stations at strategic locations in process units (for supply of LP steam, Nitrogen, Industrial Air, Service water), Fire Proofing of structures, ROVs (Remote Operated Valves), EIVs (Emergency Isolation Valves), Redundancy in trips (1 oo 1; 2 oo 3) and avoidance of spurious trips ;SIL (Safety Integrity Level) in process safety, HIPS (High Integrity Protection System),Shutdown system reset – Field or Controlled room, Centralized Vs Decentralized Control centre, Need of Chemical filter in Control Room Air conditioning, Cyber-attack prevention, Mutual aid plan. Case Studies – From Peer Industries on Performance Benchmark, Process safety Management, Safety Culture, Asset Integrity, Litigations, Safety & Environmental Incidents, etc.		
Unit-II	ELECTRICAL SYSTEMS	(9)
Power systems – KV level, 3 phase and single phase, LT, HT generation and distribution network systems, MCC / PCC (motor control centre and power control centre) substations, Electrical Energy Audits, Exergy analysis, Cogen design aspects ; Emergency Power needs based on process criticalities (including power back up for fire water and plant safe shut down), Load shedding, Essential and Non-essential power load ;Uninterrupted Power System (UPS), Load assessment for UPS, Battery bank ;Earth pit design and maintenance aspects, Earth – Neutral Differential & impacts of stray voltage, Fault Level and its relevance in industry, Start-up load, Power from two independent Sources, Relay / Fuse Coordination. Electrical load distribution and its influence on safety relief / flare load in an industrial complex, Interphase with DCS (Distributed Control System), PLCs (programmable logic controls), I/P (Current to Pneumatic transmission) convertor failures ;An overview on electrical failures viz. cable fault, over load, over voltage due to surges, lightning strokes, aging of conductor, internal & external stresses on the conductors, spike in power banks, etc., Case Studies – Industries experiences on Steam – Power balance for efficiency enhancement, smart debottlenecking to minimize cable routing & MCC / PCC use, Safety & Environmental Incidents, etc.		
Unit-III	FLARE SYSTEM	(9)

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LP, HP, LLP and H₂S flares, Types – Single Point Flares (Sonic & Subsonic), Multi Point Flares, Coanda Flares, Vent Tips, Enclosed Flares and Air Assisted Gas Flares ;Pilot gas system, Electronic ignition, Flare tip design, Flare noise reduction, Fire Ball prevention, Smokeless flare at worst weather conditions, Radiation impact zone, Flare release scenarios (fire, blocked mode, partial and total power failure), Nitrogen purge, flare header network design; Safety margins in design, Assessing flare loss in a multi units complex where metering individual headers is near impossible ;Flare gas recovery and Zero Flare release, Flare gas quality tracking and hydrogen management in refineries & petrochemicals. Case Studies – Industries experiences viz. Flare tips & header maintenance, Trouble shooting, Smart debottlenecking of units to limit flare load within capacity, Safety & Environmental Incidents, etc.

Unit-IV	RISK MITIGATION MEASURES	(9)
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HAZOP (Hazard and Operability Study), HAZID (Hazard identification), HAZAN (Hazard Analysis), EERA (Emergency escape route analysis), SIL (Safety Integrity levels) study, QRA (Quantitative Risk Assessment)and Dispersion studies ;Trip reset (Field and Control Room) and MSDS (Material Safety Data Sheet) for all streams being handled, Bow Tie Analysis, Risk Evaluation using 8 x 8 Matrix, FMEA (Failure Modes And Effects Analysis),Insurance premium assessment and measures to minimize ;Best practices – Updated documentation, SOPs (Standard Operating Procedures), SMPs (Standard Maintenance Procedures), PSM audits, Competency mapping and enhancement, employee loyalty programme, etc. Business risk – Risk in transportation of feed and products especially in sea routes (marine pollution); HSE norms non-compliance; Act of force majeure; etc. Case Studies – Industries experiences such as Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.

Unit-V	PROCESS CONTROL & INSTRUMENTATION	(9)
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Pneumatic (analogue controls) to DCS journey, Single loop Vs Multi loop controls, I/O cards, Graphic design & grouping to minimize user latency in process control ;Designed for safety through redundancy right from dedicated impulse lines to card level, PLC (Programmable Logic Controls), Cascaded Control, Process Historian, Online reporting by exception, Inferential predictions ;Use of AI / ML in controlling plant within best operating zone, QMIs (Quality Measuring Instruments), Alarm rationalization, Operator Fatigue ;Functional designs in delayed (by a few seconds) trip, Machine monitoring viz. signature analysis (vibration and axial displacement), surge control with differing mol wt of process gas, tribology analysis ;Emphasis on lab instrumentation to get “tell-tale” indications on existence of unsafe conditions, hand held instrumentations to work in confined space, communication system (field & control room, etc.) etc. CCTV at select places to monitor and alert well in advance. Centralized fire control panel for the whole premises by way of wired network of safety sensors. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.

Total No of Periods to be Taught	45
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TEXT BOOK:

1	Chemical Process Safety: Fundamentals With Applications - DANIEL A CROWL
2	Fundamentals of Process Safety Engineering - Samarendra Kumar Biswas

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REFERENCES:

1	Chemical Process Safety - Aarti Kashyap
2	Process Safety - Klein James A and Bruce K Vaughan

COURSE OUTCOMES:

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

CO1:	learn the safety systems both to prevent incident & to minimize loss
CO2:	understand the safety in electrical systems
CO3:	knowledge on flare systems and their safety
CO4:	get thorough knowledge on risk analysis and mitigation
CO5:	knowledge on the control systems and their safety usage in different process industries

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	1	1	1	2	1	1	2	2	2
CO2	2	2	3	3	2	1	1	1	2	2	2	2	2	2
CO3	2	2	3	3	3	1	1	1	2	1	1	2	2	2
CO4	2	2	3	3	3	1	1	1	1	2	2	2	2	2
CO5	2	2	3	2	2	1	1	1	2	1	2	2	2	2
Avg.	2	2	3	3	2	1	1	1	2	1	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2434	MATERIAL SELECTION	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand various degradation mechanism that engineers' face in chemical plants - To mitigate with right choice metallurgy or chemical solution or operational changes					

Unit-I	CORROSION	(9)
Different Degradation Mechanism as seen in various Chemical process industries, Corrosion (wet H₂S, Naphthenic acid bearing Crude Processing, CO₂ stress corrosion cracking, polythionic acid formation potential, amine stress corrosion cracking, microbiologically induced corrosion, corrosion under insulation, galvanic corrosion, caustic embrittlement, introduction & diffusion of hydrogen, Chloride stress corrosion cracking, etc.) ;Monitoring and prevention, NACE (National Association of Corrosion Engineers) guidelines, Life Cycle Cost Optimization and right MOC (Material of construction), Trade-off between MOC Vs Chemical inhibitors / Additives Solutions ;'NO HARM' requirements in chemical solutions, Operation within 'best operating zone', Corrosion coupons and test methods in lab, Need & challenges in asset Integrity management, Coatings, Leak Detection & Repair. Case Studies – From Industries on operational excellence viz. Trouble shooting, Efficacy of chemicals, Processing different feedstocks with confidence, Design tips, Safety & Environmental Incidents, etc.		
Unit-II	ASSETS RELIABILITY ENHANCEMENT & INCIDENT ELIMINATION	(9)
Risk envelope, Inputs on FERT (Fire, Explosivity, Reactivity and Toxicity), Quantification of unplanned interruption viz. impact on Safety, Environment and Loss of properties / business erosion, Early Event Detection using AI / ML, Surface Chemistry, Advanced Lab Techniques (SEM - Scanning Electron Microscopy, Corrosion probes, Field Signature Method, Non-intrusive techniques, Ultimate Analysis, Atomic ratios on debris, Tell-Tale Indications, etc.), Case Studies – From Industries on process / equipment reliability viz. Asset integrity, Asset sweating within safe operating window, Design errors, Safety & Environmental Incidents, Human factors, etc.		
Unit-III	FLOW AND ACOUSTIC INDUCED VIBRATION IN PIPES	(9)

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Flow Induced Vibration in pipes: Flow regimes – Slug flow, plug flow, annular, dispersed, etc. Flows in Vertical and Horizontal pipes, Design criticalities in two phase (gas & liquid) and slurry flow (solid and liquid), Handling of steam condensate & prevention of water hammering, Piping Configurations for symmetrical flow distribution, Use CFD (Computational Fluid Dynamics) to assess - selective erosion in some section of pipes, cycling pattern of vibration, heat flux or fluid film temperature variation in heater tubes, etc., Suitability of Material of Constructions for different operating severity and feed stocks including changes in process conditions during start up, shut down, catalyst pre-sulphating, etc. Acoustic induced vibrations in pipes due to high velocity gas streams in pipes (Near sonic velocity conditions). Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting and controlling flow regimes to avoid vibration, Design tips, Safety & Environmental Incidents, etc.

Unit-IV	FOULING AND COKING	(9)
Asphaltenes precipitation, Wax deposits, Gum formation, Ageing of hydrocarbon on prolonged storage and filter plugging ;Dewatering and prevention of ingress of corrosion products leading to fouling, dead zone (stagnant) prevention, Inserting storage tanks to avoid oxidation induced feed / product degradation, Incompatibility of mixing, Shear stress assessment, Assessment of Coke precursors and elimination / removal during processing ;Chemical (anti-foulant) additives to mitigate fouling / coking, process variables impacting fouling specially in exchangers, heater pipes and column internals, Methods of decoking – steam-air decoking, mechanical, pigging and spalling ;Use of quench oil in gas / naphtha cracker heaters to keep asphaltenes in suspension, polymerisation prevention, hypothesis on coking viz. pyrolytic coke, filamentous coke, amorphous coke formation, etc. Case Studies – From Industries on operational excellence viz. Trouble shooting, Efficacy of chemicals, Processing different feedstocks with confidence, Design tips, Safety & Environmental Incidents, etc.		
Unit-V	ADVANCEMENT IN MATERIAL SCIENCE	(9)
Academy to list the course content including use of graphene, metal organic framework, super conductors, replacement of Lithium for battery making, etc. In addition, Nano materials, there are lot more efforts needed to minimize dependence on import for some of the metals used in catalyst, defence needs, etc. which can only be substituted with effective end application needs and metallurgy and or alloy use. Case Studies – From market and strategic needs.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Corrosion Mechanisms (Chemical Industries) - Florian Mansfeld
2	Organic Chemicals in the Environment Mechanisms of Degradation and Transformation - Alasdair H. Neilson, Ann-Sofie Allard

REFERENCES:

1	NACE documents - American Petroleum Institute (API) 571 standards
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COURSE OUTCOMES:

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

CO1:	understand the basic concept on corrosion and their types in chemical industry
CO2:	know the degradation mechanism that engineers' face in chemical plants
CO3:	recognize the different flows in pipes and their acoustic induced vibrations
CO4:	gain knowledge in the concept of fouling in pipes and different methods of decoking
CO5:	gather some knowledge on advancement in material science usage.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	2	2	2	1	2	2	2	2	2
CO2	2	2	2	2	1	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	1	2	2	2	1	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	1	2	2	2	1	2	2	2	2	2
Avg.	2	2	2	2	1	2	2	2	1	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2435	STATUTORY REQUIREMENTS AND CUSTOMER CARE	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the purpose of competitive edge within the regulatory systems set - To leverage learning to become SMART manufacturer within norms of responsive care					

Unit-I	PEOPLE AND PROCESS SAFETY	(9)
Factory Act, IBR (Indian Boiler Regulations), Weights & Measures, Power Connection from State Electricity Board, Labour Legislation, Compensation, Fines, Litigations, Image, etc. and other commercial approvals like company registration, GST Registration, IT act, Excise Regulations etc. For operations under EOU (Export oriented units) or SEZ (Special Economic Zones), take additional approval from Export Processing Zone (EPZ) and SEBI. Case Studies – Assess the number of days taken for all such approval and apply LEAN to crunch time.		
Unit-II	ENVIRONMENTAL REGULATIONS	(9)
Water act, Air act, for highly polluting industry category EIA (Environment Impact Assessment) is mandatory, Environmental Protection Act, Licence needed for 'Drugs & Pharmaceuticals' from State Drug Controller, Hazardous substance management, Waste Management rules, Pollution Control Boards / Consent to operate (State and Union Government) specially for Industries Requiring Water and Affecting Effluent Disposal... Case Studies – Assess the number of days taken for all such approval and apply LEAN to crunch time. Additionally, benchmark on HSE norms to compare with peer industries for improvement options.		
Unit-III	CUSTOMER CARE	(9)
Customer definition, Kano Model, CRM, PFABFS model (Property, Feature, Advantage, Benefit and Savings both monetary and emotional value); Product Supply Specification based on end use applications with competitive edge over peer industries; Quality Cost, Custody transfer precision, Wing to Wing co-operation with customers / suppliers to enhance value chain returns; Development of new products and services – Ideation, proof of concept, pilot run & commercialization. Case Studies – Products & Services that made difference, Companies that disappeared when changes were not picked up in time, Point of Sale tips for lasting impression, Cycle time to launch new product.		
Unit-IV	INTERNSHIP PREPARATION AND DO'S & DON'TS	(9)

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Safety Contact, Mandatory use of PPE, Assembly points, Alarm station, Mock drills, Firefighting apparatus use on demand, know the escape routes; Shadow the trainer, learning objective – pick any one viz. Catalysis – past say three to five catalyst change, the conversion variation, generation of low value side reactions, sintering & loss of margin, H₂ loss, any tell-tale indications from apple core tests of spent catalyst, Deep dive into design of say, heat exchangers network with a view to achieve O&M excellence, Asset reliability – O&M efforts to continuously track PSM critical equipment, Energy benchmarking, Overall processing margins against best in class peer industries, Inventory management and assessment of revenue by blocked investment, Water management, etc. Case studies – In nearby cluster of industries at Tamil Nadu, assess O&M gaps and work to bridge the gap, learn about competencies gaps, past LFIs with RCA initiated, etc.

Unit-V	SUSTAINABILITY REPORTING	(9)
Understanding aspects like 'Net Zero Concept', Green House Gases release reduction, ZLD (zero Liquid discharge), Benefits to the society, Concepts of linear economy and circular economy, Life Cycle Analysis, Think Global and Act Local, learn on 17 Sustainable Development Goals as per UN charter, Use Global Reporting Initiative (GRI) formats for Sustainability reporting, Project assignment – Work on Sustainability reporting for nearby cluster of industries in Tamil Nadu		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Beyond Competitive Advantage - Todd Zenger, 2016
2	Competitive Advantage: Creating and Sustaining Superior performance – Michael E. Porter

REFERENCES:

1	Sustainability What Everyone Needs to Know - Paul B. Thompson, Patricia E. Norris
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COURSE OUTCOMES:

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

CO1:	understand the basis on different acts and their regulations
CO2:	basic knowledge in different ACT on water, air and environmental protection
CO3:	knowledge on the preparation of Kano model, CRM, PFABFS
CO4:	gain the knowledge on Do's and Don'ts in an internship program
CO5:	understand the concepts of ZLD, GHG release and circular economy

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	2	1	1	2	2	2	2	2	-	2
CO2	2	-	-	-	2	1	1	1	2	2	2	2	2	2

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CO3	2	2	2	2	2	1	1	2	2	2	2	2	2	2
CO4	2	-	-	-	2	1	1	2	2	1	2	2	2	2
CO5	2	-	1	2	2	1	1	1	2	1	2	2	2	2
Avg.	2	1	1	1	2	1	1	1	2	1	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	203 - CHEM
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHPE2436	PROCESS PLANT UTILITIES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the design and management of utilities system in any chemical industry - To apply energy conservation techniques right at design and strive net zero emission					

Unit-I	BASIC UTILITIES	(9)
Air (Industrial Service and Instrument), Cold Box air Liquification Plant, Nitrogen, Inert gas generation; Water (Potable, Service, Utility, Cooling Boiler Feed water, DM water, Desal water, RO permeate, etc.); Steam (High Pressure, Medium, Low and Very Low-pressure system), Condensate Polishing, Hot oil system, Thermic fluids for energy supply to Process equipment. Associated control equipment to monitor and prevent Water Pollution, Air Pollution control equipment, Solid waste storage area as per Waste management Rules. Also, discuss about the need to control slop generation in chemical industries. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-II	POWER GENERATION & DISTRIBUTION	(9)
Power Generation & Distribution: Gas turbines (types of fuel Vs operational reliability), Open and closed cycle, Steam Turbine generators, Power Recovery Turbo generators, IC Engines Power Generators, Renewables Power – Solar, Wind, Waves, Geo thermal, Biomass, Fuel Gas / Fuel Oil network, Impacts of utility failures (partial and or full).Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-III	WASTEWATER TREATMENT	(9)
Wastewater Treatment: Bioremediation, WWTP (Wastewater Treatment Plants along with separation system and biochemical processes to reduce BOD / COD (Biochemical Oxygen Demand and Chemical Oxygen Demand), Recalcitrant material adding to COD, Considerations in deployment of RO Membrane and reuse of treated water. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-IV	GAS PROCESSING	(9)
LNG/ CNG, Refinery Gas Treating, Sour Gas Processing, Amine Absorption and Regeneration Processes, Sulphur Recovery & Removal, Gas dehydration & Dew pointing. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.		
Unit-V	COOLING WATER SYSTEM	(9)

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Cooling water System: Cooling towers (CT), Wet and Dry Bulb and its relation to CT performance, Induced Vs Natural Draft CT, COC (Cycle of Concentration), Minimize / eliminate drift loss, CW network, assessment of cooling effectiveness in multiple parallel exchangers with availability of combined flow. Case Studies – From Industries on operations & maintenance aspects viz. Trouble shooting, Efficiency / Effectiveness tracking, Debottlenecking, Design tips, Safety & Environmental Incidents, etc.

Total No of Periods to be Taught

45

TEXT BOOK:

- | | |
|---|---|
| 1 | Introduction to Process Engineering and Design – Shuchen B Thakore & Bharat I Bhatt (2017) McGraw Hill 2nd Edition. |
| 2 | Plant Utilities - D. B. DHONE Publisher Nirali Prakashan, 2018 |

REFERENCES:

- | | |
|---|--|
| 1 | A Working Guide to Process Equipment - Norman Lieberman, Elizabeth Lieberman |
|---|--|

COURSE OUTCOMES:

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

- | | |
|------|---|
| CO1: | gain knowledge in the importance of process plant utilities |
| CO2: | Understand the Requisites of Industrial Water and treatment methodologies |
| CO3: | be familiar on various types of steam generators and boiler corrosion |
| CO4: | Understand the concept of refrigeration used in industries |
| CO5: | Learn the classification of compressors and humidification equipments |

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	1	2	2	2	2	2	2
CO3	2	2	2	2	2	1	1	1	2	2	2	2	2	2
CO4	2	2	2	2	2	1	1	1	2	2	2	2	2	2
CO5	2	2	2	2	2	2	1	1	2	2	2	2	2	2
Avg.	2	2	2	2	2	1	1	1	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHOE2401	NANOMATERIALS AND APPLICATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understanding the classification and types of polymers. understand different types of nanomaterials for the future engineering applications - Gaining knowledge on polymer analysis and solution properties - Having knowledge on the structure and properties of bulk polymers - Having knowledge on the commercial polymers - Acquiring knowledge on polymer processing techniques					

Unit-I	NANOMATERIALS	(9)
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.		
Unit-II	THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS	(9)
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.		
Unit-III	PROCESSING	(9)
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.		
Unit-IV	STRUCTURAL CHARACTERISTICS	(9)
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis		
Unit-V	APPLICATIONS	(9)
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.
2	Carl C. Koch (ed.), Nanostructured Materials, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

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REFERENCES:

1	Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003.
2	Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004.

COURSE OUTCOMES:

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

CO1:	Evaluate nanomaterials and understand the different types of nanomaterials
CO2:	Recognise the effects of dimensionality of materials on the properties
CO3:	Process different nanomaterials and use them in engineering applications
CO4:	Use appropriate techniques for characterizing nanomaterials
CO5:	Identify and use different nanomaterials for applications in different engineering fields.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	-	-	-	-	-	2	1	2
CO2	3	1	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	2	1	2	-	-	-	-	-	-	-	2	2	2
CO4	3	1	-	3	-	-	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	2	2
Avg.	2.8	1.6	1.7	2.2	-	-	-	-	-	-	-	2	1.8	2

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Department	Chemical Engineering	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHOE2402	POLYMER TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understanding the classification and types of polymers. understand different types of nanomaterials for the future engineering applications - Gaining knowledge on polymer analysis and solution properties - Having knowledge on the structure and properties of bulk polymers - Having knowledge on the commercial polymers - Acquiring knowledge on polymer processing techniques					

Unit-I	INTRODUCTION TO POLYMERS AND POLYMERIZATIONS	(9)
Polymers - Basic concepts - Classification - Natural and synthetic polymers, thermoplasts and thermosets. Polymerization - Addition, condensation, ring opening, copolymerization, ionic and coordination polymerization - Kinetics of polymerization.		
Unit-II	POLYMER ANALYSIS AND SOLUTION PROPERTIES	(9)
Molecular weight and distribution- Number average, weight average, viscosity average and Z-average molecular weight - Determination by light scattering, solution viscosity and gel permeation chromatography. Degree of polymerization. Glass transition temperature - Theory and measurements. Polymer solutions- Solubility and swelling, Thermodynamics of polymer solutions, Phase separation in polymer solutions.		
Unit-III	STRUCTURE AND PROPERTIES OF BULK POLYMERS	(9)
Morphology and order in crystalline polymers -crystal structure of polymers, morphology of polymer single crystals. Rheology and the mechanical properties of polymers - Viscous flow, kinetic theory of rubber elasticity and viscoelasticity, stress-strain behavior, compression vs tensile tests, deformation of solid polymers. Thermal analysis of polymers using TGA and DSC.		
Unit-IV	MANUFACTURE AND PROPERTIES OF COMMERCIAL POLYMERS	(9)
Hydrocarbon plastics and elastomers - low density (branched) polyethylene, high density (linear) polyethylene, polypropylene, natural rubber, rubbers derived from butadiene. Other carbon chain polymers polystyrene, acrylic polymers, poly(vinyl esters) and derived polymers. Heterochain thermoplastics - Polyamides. Thermosetting resins - Phenolic resins and amino resins.		
Unit-V	POLYMER PROCESSING TECHNIQUES	(9)
Plastic molding techniques - Injection, blow, extrusion and compression. Processing agents - Fillers, plasticizers, and other additives. Fiber Technology - Textile and fabric properties, spinning - wet and dry methods - fiber treatments. Elastomer technology - Compounding and elastomer properties, vulcanization and reinforcement.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Billmeyer F.W., Textbook of Polymer Science, Third Edition, Wiley Interscience, 1984.
2	Charles E., Carraher Jr., Seymour/carraher's polymer chemistry, Seventh Edition, CRC Press, 2012.

REFERENCES:

1	Fried J.R., Polymer Science and Technology, Second Edition, Prentice Hall of India Pvt Ltd., 2003.
2	Bhatnagar M.S., A Textbook of Polymers, Vol. 2, S.Chand and Company Ltd., 2012s.

COURSE OUTCOMES:

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

CO1:	Understand the basic concepts of polymer science and identify the polymerization techniques and its kinetics.
CO2:	Assess the molecular weight distribution techniques, glass transition, and solution properties like thermodynamics, phase separations.
CO3:	Explain the morphology, rheology, mechanical and thermal properties of bulk polymers.
CO4:	Compare and analyze the manufacture and properties of commercial polymers.
CO5:	Apply the knowledge in assessing the polymeric, fiber and elastomer processing techniques.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	-	3	-	-	-	2	3	1	-	2	-
CO2	2	3	3	-	3	-	-	-	2	3	1	-	2	-
CO3	2	3	3	-	3	1	-	-	-	3	1	-	2	-
CO4	2	3	3	-	3	1	-	-	2	3	1	-	2	-
CO5	2	3	3	-	3	1	-	-	2	3	1	-	2	-
Avg.	2	3	3	-	3	1	-	-	2	3	1	-	2	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name			Open to all Departments	
Semester						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHOE2403	ENZYME ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	Focuses on the introduction to enzymes and gives an overview of kinetics, production immobilization, fermentation process and its industrial applications.					

Unit-I	ENZYMES AND KINETICS	(9)
Classification of enzymes; Principle of enzymatic catalysis; Enzyme kinetics-Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition.		
Unit-II	ENZYME PRODUCTION	(9)
Extraction of crude enzyme from plant, animal and microbial source; Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.		
Unit-III	ENZYME IMMOBILIZATION	(9)
Immobilization Type: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect.		
Unit-IV	LARGE SCALE PRODUCTION	(9)
Fermentation using continuously stirred aerated tank bioreactors. Mixing power correlation. Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power.		
Unit-V	INDUSTRIAL APPLICATIONS OF ENZYMES	(9)
Industrial Enzymes in:Dairy, Bread making, Starch processing, Brewing; Bioethanol production and other fermentation processes; Thermophilic enzymes, amylases, lipases, proteolytic enzymes in Meat and Leather industry, Cellulose degrading enzymes in Paper and Pulp industry; Metal degrading and pollutant degradation. Biosensors		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Nicolas C. Price and Lewis Stevens, "Fundamentals of enzymology: Cell and Molecular Biology of Catalytic Proteins", 3rd Edition, Oxford University Press, United States of America, 2000 for Unit I.

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2	Young JeYoo, Yan Feng, Yong Hwan Kim Camila Flor J. Yagonia, "Fundamentals of Enzyme Engineering", 1st Edition, Springer Inc, United Kingdom, 2017 for Units II, III, IV & V.
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REFERENCES:

1	Trevor Palmer and Philip Bonner, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd Edition, Woodhead Publishing, United Kingdom, 2001.
2	Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004

COURSE OUTCOMES:

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

CO1:	Classify enzymes and elaborate the principles of catalysis and enzyme kinetics
CO2:	Describe the enzyme production, purification, characterisation and assay
CO3:	Outline the immobilization of enzymes
CO4:	Elaborate the large scale fermentation process using bioreactors
CO5:	Apply enzyme science in its industrial applications

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	1	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	1	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	-
Avg.	3	3	3	3	-	-	-	-	-	-	-	-	-	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name			Open to all Departments	
Semester						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHOE2404	Bio Energy Resources	L	T	P	C	100
		3	0	0	3	
Course Objectives	Focuses on the introduction to bioenergy and gives an overview of resources, gasification and combustion processes.					

Unit-I	(9)
Energy perspective: Current methods, Biomass possibilities. Fundamental concepts in understanding biofuel and bioenergy production: Mass Balances, Energy Balances, Thermodynamics, Organic compounds, Chemistry of plant materials resources.	
Unit-II	(9)
Biogas technology: Feedstock for producing biogas; Microbial and biochemical aspects and operating parameters for biogas production, Kinetics and mechanism. Dry and wet fermentation, Digestors for rural application-High rate digesters for industrial waste water treatment.	
Unit-III	(9)
Pyrolysis and thermo-chemical conversion: Thermo-chemical conversion of lignocellulosic biomass. Incineration for safe disposal of hazardous waste, Biomass processing for liquid fuel production, Pyrolysis of biomass-pyrolysis regime, effect of particle size, temperature, and products obtained.	
Unit-IV	(9)
Comparison of Bio-energy Sources, Biorefinery, Biofuels for Transportation, Vegetable Oils as Engine Fuels. Biodiesel as Engine Fuel: Engine Emissions from Biodiesel, Biodiesel production by using various microorganisms, algae and Transesterification process, methods of biodiesel production.	
Unit-V	(9)
Combustion of biomass and cogeneration systems: Combustion of woody biomass-theory, calculations and design of equipment, Cogeneration in biomass processing industries. Case studies: Combustion of rice husk, Use of bagasse for cogeneration	
Total No of Periods to be Taught	45

TEXT BOOK:	
1	Anju Dahiya, Bioenergy: Biomass to biofuels First Edition, Academic Press, 2014.
2	Li, Yebo, and Samir Kumar Khanal. Bioenergy: principles and applications. John Wiley & Sons, 2016.





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REFERENCES:

1	Vaughn C Nelson, Kenneth L. Starcher. Introduction to bioenergy. CRC Press, 2017.
2	Wall, Judy D., Caroline S. Harwood, and Arnold Demain. "Bioenergy." Bioenergy.. ASM Press, 2008.

COURSE OUTCOMES:

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

CO1:	Understand the fundamental knowledge on energy perspective
CO2:	Learn the production of biogas
CO3:	Gather knowledge on the operations of incineration, pyrolysis.
CO4:	Understand the comparison of bioenergy sources
CO5:	Knowledge on the types of combustion of biomass.

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	2	2	1	1	1	1	2	1	2
CO2	2	-	2	1	2	2	2	1	1	1	2	2	2	2
CO3	2	1	2	1	2	2	2	2	1	1	2	2	1	2
CO4	2	1	2	1	2	2	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	2	1	1	1	2	2	1	2
Avg.	2	1	2	1	2	2	2	1	1	1	1	2	1	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	Chemical Engineering	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCHOE2405	CHEMICAL PROCESS SAFETY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Teach the principles of safety applicable to the design, and operation of chemical process plants. • Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy. • Learn about the hazardous chemicals into locations that could expose employees and others to serious harm. • Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals. • Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.					

Unit-I	SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES	(9)
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.		
Unit-II	CHEMICAL REACTION HAZARDS	(9)
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.		
Unit-III	SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS	(9)
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.		
Unit-IV	SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS	(9)
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.		



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Unit-V	SAFETY AND ANALYSIS	(9)
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	George Kanwaty, "Introduction to Work Study ", ILO, Geneva, 1996, ISBN: 9221071081 ISBN-13: 9789221071082
2	Enrick N. L., "Time study manual for Textile industry", Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 ISBN-13: 9780898740448
REFERENCES:	
1	Norberd Lloyd Enrick., "Industrial Engineering Manual for Textile Industry", Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 ISBN-13: 9780882756318
2	Chuter A. J., "Introduction to Clothing Production Management", Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 ISBN-13: 9780632039395

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2:	Develop thorough knowledge about safety in the operation of chemical plants.
CO3:	Apply the principles of safety in the storage and handling of gases.
CO4:	Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5:	Develop thorough knowledge about safety and analysis.

Mapping of COs with POs and PSOs														
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	2	1	1	2	2	1	1	1
CO2	1	2	2	2	2	1	2	1	2	2	2	2	1	1
CO3	1	2	2	1	1	2	2	1	2	1	2	2	1	3
CO4	1	2	2	1	1	1	2	1	1	1	1	2	2	1
CO5	2	2	3	2	2	1	2	1	1	2	2	1	1	3
Avg.	2	1	1	1	2	1	2	2	2	2	2	2	1	2
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														


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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2401	Introduction to C Programming		L	T	P	C	100
			2	0	2	3	
Course Objectives	- Understand the basic structure and syntax of C programming language. - Develop logical thinking and problem-solving skills. - Apply control structures, functions, and arrays. - Understand pointers, structures, and file handling. - Gain practical experience through lab exercises.						

Unit-I	INTRODUCTION TO C PROGRAMMING	(6)
History and Features of C-Structure of C Program-Character Set, Tokens, Keywords, -Identifiers- Constants and Variables-Data Types (int, float, char, double)-Operators: Arithmetic, Relational, Logical, Assignment-Expressions and Precedence-Input and Output Functions (printf, scanf).		
Unit-II	CONTROL STATEMENTS	(6)
Decision Making: if, if-else, nested if, switch-case -Looping: for, while, do-while-Nested loops Jump Statements: break, continue, goto-Applications of loops.		
Unit-III	FUNCTIONS	(6)
Function Definition and Declaration-Types of Functions-Recursion-Storage Classes: auto, static, extern, register-Parameter Passing: Call by Value, Call by Reference.		
Unit-IV	ARRAYS AND STRINGS	(6)
One Dimensional Arrays - Two Dimensional Arrays - Matrix Operations-String Declaration and Initialization-String Functions: strlen, strcpy, strcat, strcmp-Applications of Arrays and Strings.		
Unit-V	POINTERS, STRUCTURES AND FILE HANDLING	(6)
Pointers and Pointer Arithmetic-Pointers with Arrays and Functions-Structures and Unions-File Handling: fopen, fclose, fprintf, fscanf, fgets, fputs-File Modes and Applications.		
Total No of Periods to be Taught		30 Periods

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TEXT BOOK:

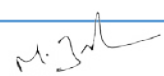
1	E. Balagurusamy, Programming in ANSI C, McGraw Hill, 9th Edition, 2024.
2	Kernighan & Ritchie, The C Programming Language, 2nd Edition, 1988.

REFERENCES:

1	Yashavant Kanetkar, Let Us C, BPB, 20th Edition, 2024.
2	Herbert Schildt, C: The Complete Reference, McGraw Hill, 4th Edition, 2000.
3	Byron Gottfried, Programming with C, McGraw Hill, 1996.

List of Exercises/Experiments

1. Implement a C program to display Hello World.	
2. Implement programs using input and output operations.	
3. Implement programs using arithmetic and logical operators.	
4. Implement decision making programs (if, switch).	
5. Implement looping programs (for, while, do-while).	
6. Implement functions and recursive programs.	
7. Implement array operations (1D and 2D arrays).	
8. Implement string handling programs.	
9. Implement pointer-based programs.	
10. Implement structure and file handling programs.	
Total No of Periods to be Taught	30 Periods


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COURSE OUTCOMES:

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

CO1:	Explain C fundamentals.
CO2:	Apply control structures.
CO3:	Develop programs using arrays and functions.
CO4:	Implement pointers and structures.
CO5:	Design file-based applications neural networks for various tasks.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Turbo C Compiler	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	0	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	0	1	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO5	3	3	3	2	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.8	2.2	1.2	1.8	0	0	0	0	0	1.2	3	2.8	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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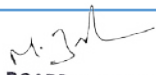
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2402	Introduction to Data Structures		L	T	P	C	100
			2	0	2	3	
Course Objectives	- To understand fundamental data structures. - To analyze and design algorithms. - To implement linear and non-linear data structures. - To evaluate performance of algorithms. - To apply data structures in problem solving.						

Unit-I	Introduction to Data Structures	(6)
Definition and Classification of Data Structures-Abstract Data Types (ADT)-Algorithm -Analysis: Time and Space Complexity-Asymptotic Notations: Big-O, Theta, Omega-Recursion and its applications.		
Unit-II	Linear Data Structures	(6)
Arrays and their operations-Linked Lists: Singly, Doubly, Circular-Stack ADT: Operations and Applications-Queue ADT: Linear Queue, Circular Queue, Deque-Applications of Stacks and Queues.		
Unit-III	Searching and Sorting	(6)
Linear Search and Binary Search-Sorting Techniques: Bubble, Selection, Insertion-Divide and Conquer: Merge Sort, Quick Sort-Hashing: Hash Functions, Collision Handling-Performance Analysis of Searching and Sorting.		
Unit-IV	Trees	(6)
Tree ADT and Terminologies-Binary Trees and Traversals (Inorder, Preorder, Postorder)-Binary Search Trees-AVL Trees-Heaps and Priority Queues.		
Unit-V	Graphs	(6)
Graph ADT and Representations-Graph Traversals: BFS and DFS-Directed Acyclic Graphs (DAG)-Shortest Path Algorithms-Minimum Spanning Trees.		
Total No of Periods to be Taught		30 Periods


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TEXT BOOK:

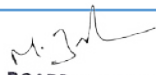
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd Edition, 1997.
2	Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia, 1976.

REFERENCES:

1	Seymour Lipschutz, Data Structures, Schaum's Outline, McGraw Hill, 2011.
2	Reema Thareja, Data Structures Using C, Oxford University Press, 2014.
3	YedidyahLangsam, Moshe Augenstein, Data Structures Using C and C++, Pearson.

List of Exercises/Experiments

1. Implement array operations.	
2. Implement singly linked list operations.	
3. Implement doubly and circular linked lists.	
4. Implement stack operations using array/linked list.	
5. Implement queue operations (linear and circular)	
6. Implement searching algorithms (linear, binary).	
7. Implement sorting algorithms (bubble, selection, insertion).	
8. Implement divide and conquer sorting (merge, quick sort).	
9. Implement tree traversals.	
10.Implement graph traversals (BFS, DFS).	
Total No of Periods to be Taught	30 Periods


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COURSE OUTCOMES:

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

CO1:	Explain basic data structures concepts.
CO2:	Apply linear data structures.
CO3:	Implement searching and sorting techniques.
CO4:	Analyze trees and graphs.
CO5:	Design efficient algorithms using data structures.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Turbo C Compiler	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	0	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	0	2	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	3	3	3	2	0	0	0	0	0	1	3	3	3
CO5	3	3	3	3	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.8	2.2	1.6	2	0	0	0	0	0	1.2	3	2.8	2.2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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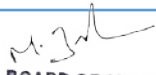
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS	
Course Code	Course Name		Hours/Week			Credit	Maximum Marks	
UCSOE2403	Data Science Fundamentals	L	T	P	C	100		
		2	0	2	3			
Course Objectives	• Familiarize students with the data science process. • Understand the data manipulation functions in Numpy and Pandas. • Explore different types of machine learning approaches. • Understand and practice visualization techniques using tools. • Learn to handle large volumes of data with case studies.							

Unit-I	INTRODUCTION	(6)
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.		
Unit-II	DATA MANIPULATION	(9)
Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance.		
Unit-III	MACHINE LEARNING	(5)
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.		
Unit-IV	DATA VISUALIZATION	(5)
Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.		
Unit-V	HANDLING LARGE DATA	(5)
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.		


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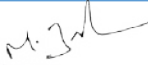


Total No of Periods to be Taught	30 Periods
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TEXT BOOK:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCES:	
1	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

List of Exercises/Experiments	
1.	Download, install and explore the features of Python for data analytics
2.	Working with Numpy arrays.
3.	Working with Pandas data frames.
4.	Basic plots using Matplotlib.
5.	Statistical and Probability measures a) Frequency distributions b) Mean, Mode, Standard Deviation c) Variability d) Normal curves e) Correlation and scatter plots f) Correlation coefficient g) Regression.
6.	Use the standard benchmark data set for performing the following: a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b) Bivariate Analysis: Linear and logistic regression modelling.
7.	Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8.	Apply and explore various plotting functions on any data set.
Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.	
Total No of Periods to be Taught	30 Periods


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COURSE OUTCOMES:

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

CO1:	Gain knowledge on data science process.
CO2:	Perform data manipulation functions using Numpy and Pandas.
CO3:	Understand different types of machine learning approaches.
CO4:	Perform data visualization using tools.
CO5:	Handle large volumes of data in practical scenarios.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Idle Python (latest version)	
3.	Jupyter Notebook	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	3	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	2	2	1	3	0	0	0	0	0	1	3	3	2
CO5	3	3	3	3	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.6	2.2	1.4	2.4	0	0	0	0	0	1.2	3	2.8	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2404	Introduction of Data Analytics		L	T	P	C	100
			2	0	2	3	
Course Objectives	- Understand the fundamental concepts of Data analytics. - Learn about various types of data formats and its manipulations. - It helps students to learn exploratory data analysis and visualization techniques in addition to R/Python/Tableau programming language.						

Unit-I	INTRODUCTION TO DATA SCIENCE	(5)
Introduction to Data Science, Need for Data Science, the 5 V's, Evolution of Data Science, Data Science Lifecycle, types of Data Analysis, Data Science Tools and technologies, Applications of Data Science in various fields.		
Unit-II	DATA HANDLING	(7)
Types of Data: structured, semi-structured, unstructured data, Numeric, Categorical, Graphical, High Dimensional Data, Transactional Data, Spatial Data, Social Network Data, standard datasets, Data Classification, Sources of Data, Data manipulation in various formats, import and export data in R/Python.		
Unit-III	DATA PRE-PROCESSING	(6)
Data Cleaning: - missing values, noisy data; Data Transformation: -Normalization, Attribute Selection, Discretization, Hierarchy Generation; Data Reduction: - Attribute Subset Selection, Numerosity and Dimensional Reduction, Exploratory Data Analysis techniques, Concept of data munging and data wrangling, Feature generation and Feature selection algorithms.		
Unit-IV	DATA VISUALIZATION	(6)
Introduction and importance of Data Visualization, Benefits, Idea and tools; Types of Data visualization, Libraries for Data visualization, Data visualization using Python/R, Creating Dashboards & Stories Tableau: Getting started with Tableau Software, Using Data file formats, connecting your Data to Tableau, creating basic charts (line, bar charts, Tree maps).		
Unit-V	APPLICATION	(5)
Application of Data Science, Data Science and Ethical Issues-Discussion on privacy, security, Ethics-A look back at data science-next generation data scientists. Case Study of Data science-Facebook, uber and Amazon.		

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Total No of Periods to be Taught	30 Periods
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TEXT BOOK:

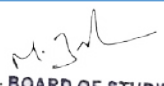
1	Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.
2	Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.

REFERENCES:

1	Open Data for Sustainable Community: Glocalised Sustainable Development Goals, Neha Sharma, Santanu Ghosh, MonodeepSaha, Springer, 2021.
2	The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017.
3	Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 2012.

List of Exercises/Experiments

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.	
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files.	
3. Implement of Matrix Multiplication with Hadoop Map Reduce.	
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	
5. Installation of Hive along with practice examples.	
6. Installation of HBase, Installing thrift along with Practice examples.	
7. Practice importing and exporting data from various databases.	
Total No of Periods to be Taught	30 Periods


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COURSE OUTCOMES:

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

CO1:	Understand the fundamental concepts of data analytics in the areas that plays major role within the realm of data science.
CO2:	Explain and exemplify the most common forms of data and its representations.
CO3:	Understand and apply data pre-processing techniques.
CO4:	Illustrate various visualization methods for different types of data sets and application scenarios.
CO5:	Understand application and ethics of Data Science.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Idle Python (latest version)	
3.	Jupyter Notebook	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	2	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	2	2	1	3	0	0	0	0	0	1	3	3	2
CO5	3	3	2	2	2	1	1	1	0	0	2	3	3	3
Avg.	3	2.6	2	1.2	2	0.2	0.2	0.2	0	0	1.2	3	2.8	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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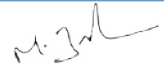
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2405	Artificial Intelligence and Machine Learning Fundamentals		L	T	P	C	100
			2	0	2	3	
Course Objectives	- Understand the importance, principles, and search methods of AI - Provide knowledge on predicate logic and Prolog. - Introduce machine learning fundamentals. - Study of supervised learning algorithms. - Study about unsupervised learning algorithms.						

Unit-I	INTELLIGENT AGENT AND UNINFORMED SEARCH	(6)
Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniformcost search - Depth First Search - Depth Limited Search.		
Unit-II	PROBLEM SOLVING WITH SEARCH TECHNIQUES	(7)
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP.		
Unit-III	LEARNING	(6)
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression.		
Unit-IV	SUPERVISED LEARNING	(6)
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM).		
Unit-V	UNSUPERVISED LEARNING	(6)


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Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets
- Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.

Total No of Periods to be Taught

30 Periods

TEXT BOOK:

- | | |
|---|--|
| 1 | S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021. |
| 2 | S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed. |

REFERENCES:

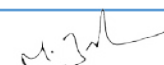
- | | |
|---|---|
| 1 | Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997. |
| 2 | I. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011. |
| 3 | C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020. |

List of Exercises/Experiments

1. Implement breadth first search.
2. Implement depth first search.
3. Analysis of breadth first and depth first search in terms of time and space.
4. Implement and compare Greedy and A* algorithms.

Supervised learning

5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.


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8. Write a program to implement the naïve Bayesian classifier.	
Unsupervised learning	
9. Implementing neural network using self-organizing maps.	
10. Implementing k-Means algorithm to cluster a set of data.	
11. Implementing hierarchical clustering algorithm.	
Total No of Periods to be Taught	30 Periods

COURSE OUTCOMES:

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

CO1:	Understand the foundations of AI and the structure of Intelligent Agents.
CO2:	Use appropriate search algorithms for any AI problem.
CO3:	Study of learning methods.
CO4:	Solving problem using Supervised Learning.
CO5:	Solving problem using Unsupervised Learning.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	2	0	0	0	0	0	1	3	3	2
CO3	3	3	2	2	2	0	0	0	0	0	1	3	3	2
CO4	3	3	3	2	3	0	0	0	0	0	1	3	3	3
CO5	3	3	3	3	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.8	2.2	1.6	2.2	0	0	0	0	0	1.2	3	2.8	2.2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Idle Python (latest version)	
3.	Anaconda	

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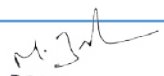
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Department		CSE		Programme Code & Name			OPEN TO ALL DEPARTMENTS	
Course Code	Course Name			Hours/Week			Credit	Maximum Marks
UCSOE2406	IOT CONCEPTS AND APPLICATIONS			L	T	P	C	100
				2	0	2	3	
Course Objectives	- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT. - To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms. - To introduce the technologies behind Internet of Things(IoT). - To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform. - To apply the concept of Internet of Things in real world scenario.							

Unit-I	INTRODUCTION TO INTERNET OF THINGS	(5)
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT .		
Unit-II	COMPONENTS IN INTERNET OF THINGS	(5)
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules).		
Unit-III	PROTOCOLS AND TECHNOLOGIES BEHIND IOT	(6)
IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.		
Unit-IV	OPEN PLATFORMS AND PROGRAMMING	(7)
IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
Unit-V	IOT APPLICATIONS	(7)
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.		
Total No of Periods to be Taught		30 Periods


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TEXT BOOK:

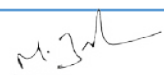
1	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.
2	Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES:

1	Perry Lea, “Internet of things for architects”, Packt, 2018.
2	. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

List of Exercises/Experiments

1. Introduction to Arduino platform and programming.	
2. Interfacing Arduino to Zigbee module.	
3. Interfacing Arduino to GSM module.	
4. Interfacing Arduino to Bluetooth Module.	
5. Introduction to Raspberry PI platform and python programming.	
6. Interfacing sensors to Raspberry PI.	
7. Communicate between Arduino and Raspberry PI using any wireless medium.	
8. Setup a cloud platform to log the data.	
9. Log Data using Raspberry PI and upload to the cloud platform.	
10. Design an IOT based system.	
Total No of Periods to be Taught	30 Periods


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COURSE OUTCOMES:

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

CO1:	Explain the concept of IoT.
CO2:	Understand the communication models and various protocols for IoT.
CO3:	Design portable IoT using Arduino/Raspberry Pi /open platform.
CO4:	Apply data analytics and use cloud offerings related to IoT.
CO5:	Analyze applications of IoT in real time scenario..

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	2	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	3	0	0	0	0	0	1	3	3	3
CO4	3	3	2	2	3	0	0	0	0	0	1	3	3	3
CO5	3	3	3	3	3	1	1	1	0	0	2	3	3	3
Avg.	3	2.8	2.2	1.6	2.4	0.2	0.2	0.2	0	0	1.2	3	2.8	2.4

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	https://www.arduino.cc/en/software/	
3.	https://www.raspberrypi.com/software/operating-systems/	

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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2401	INDUSTRIAL ELECTRONICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Study the overview of different types of power semi-conductor devices and their switching characteristics. • Acquire the knowledge of characteristics and performance parameters of controlled converters. • Measure and analyze the characteristics of DC Amplifiers. • Study about the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods. • Expose the practical application for power electronics converters in conditioning the power supply.					

Unit-I	POWER DEVICES	(9)
Power diode --Power transistor -- Power MOSFET - SCR -- TRIAC - GTO - IGBT - MCT -- Protection of power devices		
Unit-II	CONVERTERS	(9)
Introduction to half wave, full wave and bridge rectifiers - Single phase and three phase -Half controlled and fully controlled converters -- Dual converters -- Introduction to cycle converters and ac controllers		
Unit-III	AMPLIFIERS	(9)
Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascade amplifier, Stabilization, Differential amplifiers -- Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers		
Unit-IV	MOTORS	(9)
Steady state characteristic of dc motors - Control of DC motor using converters and choppers Regenerative and dynamic braking -- Closed loop control scheme - Speed-torque characteristic of induction motor -- Static stator voltage control -- V/f control -- Static rotor resistance control -- Slip power recovery scheme -- Self control of synchronous motor.		
Unit-V	INDUSTRIAL APPLICATIONS	(9)
Electronic timers -- Digital counters -- Voltage regulators - Online and offline ups -- Switched modepower supply -- Principle and application of induction and dielectric heating.		
Total No of Periods to be Taught		45 Periods

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TEXT BOOK:

1	Bogdan M Wilamowski and J David Irwin, "Fundamentals of Industrial Electronics" Second Edition, 2011
---	--

REFERENCES:

1	M. H. Rashid, "power Electronics Circuits, Devices and Application", PHI, third edition, 2004.
2	G. M. Chute and R. D. Chute, "Electronics in Industry", McGraw Hill Ltd, Tokyo, Second Edition 1995.
3	F. D. Petruzulla, "Industrial Electronics", McGraw Hill, Singapore, Second Edition 1996.

COURSE OUTCOMES:

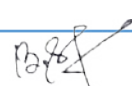
On completion of the course, the students will be able to

CO1:	Enumerate the functions of various power devices.
CO2:	Explain the various types of converters.
CO3:	Illustrate the various types of amplifiers and analyze the function.
CO4:	Construct the characteristics of DC motors and AC drives.
CO5:	Construct the application of timers and counters.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	-	-	-	-	3	2	-
CO2	3	2	3	3	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	3	3	-
CO4	3	3	2	2	-	-	-	-	-	-	-	3	3	-
CO5	3	2	2	3	-	-	-	-	-	-	-	3	2	-
Avg.	3	2	3	3	-	-	-	-	-	-	-	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Mecheri, Salem Dt-636453, Tamilnadu



Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2402	IMAGE PROCESSING AND COMPUTER VISION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• This subject emphasis on fundamentals of Image processing and Computer vision. • Students will gain the knowledge of Image Formation, Image Enhancement and Segmentation. • Students will also learn various feature extraction techniques. • This subject has more emphasis on core vision tasks through Motion estimation and Object as well as pattern recognition. • Students shall explore the areas where automation can be possible through Image processing and Computer Vision.					

Unit-I	INTRODUCTION	(9)
Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision		
Unit-II	IMAGE ENHANCEMENT	(9)
Image enhancement in spatial domain, Basic grey level Transformations, Histogram Processing Techniques, Spatial Filtering, Image smoothing and Image Sharpening, Image enhancement process in frequency domain, Low pass filtering, High pass Filtering		
Unit-III	IMAGE SEGMENTATION	(9)
Point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection		
Unit-IV	FEATURE EXTRACTION	(9)
Importance of Features, Feature extraction techniques, Histogram of Oriented Gradient (HOG), Scale Invariant Feature Transform (SIFT), Background subtraction techniques, Image Matching, Principal Component Analysis (PCA)		
Unit-V	OBJECT RECOGNITION AND MOTION ESTIMATION & APPLICATIONS OF IMAGE PROCESSING AND COMPUTER VISION	(9)
Object Recognition techniques: Viola-Jones, Yolo, Deep learning algorithms for Object Recognition. Optical Flow, Gaussian Mixture Model (GMM), Structure of Motion, Motion Estimation.& Face Recognition, Facial Expression Recognition, Optical Character Recognition, Automated Video Surveillance		
Total No of Periods to be Taught		45 Periods

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TEXT BOOK:

1	NPTEL Courses: https://onlinecourses.nptel.ac.in/noc19_cs58/preview https://onlinecourses.nptel.ac.in/noc19_ee55/preview
2	Course era Courses on Image Processing, Computer Vision

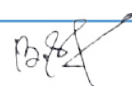
REFERENCES:

1	Digital Image Processing- Refael C. Gonzalez and Richard E. Woods, Wesley
2	Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
3	Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
4	Computer Vision, D. H. Ballard, C. M. Brown, Prentice-Hall, Englewood Cliffs, 1982.

COURSE OUTCOMES:

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

CO1:	Understand fundamentals of image processing and computer vision.
CO2:	Understand and apply concepts of Image formation and Image Enhancement.
CO3:	Understand and apply image segmentation and feature extraction methods.
CO4:	Acquire knowledge about various Object Detection, Object Recognition, Motion estimation techniques and their applications.
CO5:	Ability to apply various Image processing and Computer vision algorithms to solve real time problems.


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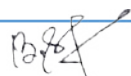
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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	-	1	-	3	3	1
CO2	3	3	3	1	-	-	-	-	-	1	-	3	3	2
CO3	3	2	2	1	-	-	-	-	-	1	-	3	2	2
CO4	3	3	3	2	-	-	-	-	-	1	-	3	3	1
CO5	3	3	3	1	-	-	-	-	-	1	-	3	3	1
Avg.	3	3	3	1	-	-	-	-	-	1	-	3	3	1

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2403	4G / 5G COMMUNICATION NETWORKS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To learn the evolution of wireless networks. • To get acquainted with the fundamentals of 5G networks. • To study the processes associated with 5G architecture. • To study spectrum sharing and spectrum trading. • To learn the security features in 5G networks.					

Unit-I	EVOLUTION OF WIRELESS NETWORKS	(9)
Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC)		
Unit-II	5G CONCEPTS AND CHALLENGES	(9)
Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G		
Unit-III	NETWORK ARCHITECTURE AND THE PROCESSES	(9)
5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE		
Unit-IV	DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES	(9)
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves		
Unit-V	SECURITY IN 5G NETWORKS	(9)
Security features in 5G networks, network domain security, user domain security, flow based QoS frame work, mitigating the threats in 5G		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019

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2	An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.
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REFERENCES:

1	5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.
2	5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications, 2019.

COURSE OUTCOMES:

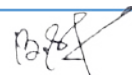
On completion of the course, the students will be able to

CO1:	To understand the evolution of wireless networks.
CO2:	To learn the concepts of 5G networks.
CO3:	To comprehend the 5G architecture and protocols
CO4:	To understand the dynamic spectrum management
CO5:	To learn the security aspects in 5G networks.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	3	2	3	2
CO4	2	3	3	2	2	1	-	-	-	-	2	2	1	2
CO5	3	3	3	2	2	1	-	-	-	-	2	2	2	2
Avg.	3	3	3	2	2	2	-	-	-	-	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2404	WIRELESS COMMUNICATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Know the characteristic of wireless channel • Learn the various cellular architectures • Understand the concepts behind various digital signaling schemes for fading channels • Be familiar the various multipath mitigation techniques • Understand the various multiple antenna systems					

Unit-I	WIRELESS CHANNELS	(9)
Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading		
Unit-II	CELLULAR ARCHITECTURE	(9)
Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement		
Unit-III	DIGITAL SIGNALING FOR FADING CHANNELS	(9)
Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR		
Unit-IV	MULTIPATH MITIGATION TECHNIQUES	(9)
Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver		
Unit-V	MULTIPLE ANTENNA TECHNIQUES	(9)
MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	Rappaport,T.S., —Wireless communications , Pearson Education, Second Edition, 2010.(UNIT I, II, IV)

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2	Andreas.F. Molisch, —Wireless Communications , John Wiley – India, 2006. (UNIT III,V)
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REFERENCES:

1	Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2	Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000
3	David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4	AUpena Dalal, —Wireless Communication , Oxford University Press, 2009.

COURSE OUTCOMES:

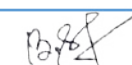
On completion of the course, the students will be able to

CO1:	Gain information on the various types of wireless channels and its parameters associated with it.
CO2:	Design cellular networks.
CO3:	Analyze probability of error of different digital modulation schemes.
CO4:	Understand receiver processing schemes for wireless communication systems for improved transceiver
CO5:	Update latest topics in wireless communication systems and its capacity analysis

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	-	-	-	-	-	3	1	1
CO2	3	3	2	1	3	2	-	-	-	-	1	3	1	2
CO3	3	3	3	3	2	2	-	-	-	-	1	3	1	2
CO4	2	3	2	2	2	2	-	-	-	-	1	2	1	1
CO5	2	-	3	3	2	1	-	-	-	-	1	2	2	2
Avg.	3	3	2	2	2	2	-	-	-	-	1	3	1	2

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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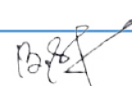
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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2405	EMBEDDED AND REAL TIME SYSTEMS	L 3	T 0	P 0	C 3	100
Course Objectives	- Study the basic of Real time systems - Learn the various uni processor and Multiprocessor scheduling mechanisms - Familiarize the real time memory and design considerations - Introduce the fault tolerant architectures - Understand the Integration of Hardware and software in real time applications					

Unit-I	INTRODUCTION	(9)
Introduction to real time computing - Concepts-Example of real-time applications -- Structure of a real time system - Characterization of real time systems and tasks - Performance metrics • Prediction of Execution Time-Source code analysis, Micro-architecture level analysis, Cache and pipeline issues- Programming Languages for Real-Time Systems		
Unit-II	DESIGN TECHNIQUES	(9)
Real time Kernels- Process Scheduling- Round Robin Scheduling-Cyclic Executives-Fixed Priority Scheduling-Rate Monotonic Approach- Dynamic Priority Scheduling-Earliest Deadline First Approach- Inter task Communication and Synchronization		
Unit-III	MEMORY MANAGEMENT	(9)
Process Stack Management - Runtime Ring Buffer - Maximum Stack Size - Multiple Stack Arrangements- Memory Management in the Task-Control - Block Model - Swapping- Overlays- Block or Page Management- Replacement Algorithms- Memory Locking- Working Sets- Real-Time Garbage Collection- Contiguous File Systems- Building versus Buying Real-Time Operating Systems- Selecting Real Time Kernels		
Unit-IV	FAULT TOLERANT ARCHITECTURES	(9)
Faults- The Role of Testing- Testing Techniques- System-Level Testing- Design of Testing Plans- Fault-Tolerance		
Unit-V	SYSTEM INTEGRATION	(9)
Goals of System Integration- System Unification- System Verification- System Integration Tools- A Simple Integration Strategy- Patching- The Probe Effect- Case Study : Fault Tolerant Design		
Total No of Periods to be Taught		45 Periods


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TEXT BOOK:

1	Laplante Philip. A, "Real-time systems design and analysis: An engineer's handbook", PHI Publication, Second Edition, 1994.
2	C.M. Krishna, Kang G. Shin, "Real Time Systems", International Edition, McGraw Hill Companies, Inc, New York, Third Edition, 2010.

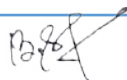
REFERENCES:

1	Jane W.S. Liu, "Real-Time Systems", Pearson Education India, First Edition, 2000.
2	Raymond J.A. Buhr, Donald L. Bailey, "An Introduction to Real Time Systems from Design to Networking with C/C++", Prentice Hall, First Edition, 1999.

COURSE OUTCOMES:

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

CO1:	Describe issues related to the design and analysis of system time constraints.
CO2:	Illustrate about various Scheduling Techniques
CO3:	Explain the various types of memory concepts Real time management
CO4:	Determine the concepts of testing and fault tolerance
CO5:	Discover the real time systems by Integration


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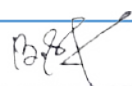
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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	3	3	1	-	-	-	1	-	3
CO2	-	-	-	1	-	3	3	2	-	-	-	1	-	3
CO3	-	-	-	1	-	3	2	2	-	-	-	1	-	3
CO4	-	-	-	1	-	3	3	1	-	-	-	1	-	3
CO5	-	-	-	1	-	3	3	1	-	-	-	1	-	3
Avg.	-	-	-	1	-	3	3	1	-	-	-	1	-	3

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week				Credit	Maximum Marks
UECOE2406	ROBOTICS AND ITS INDUSTRIAL APPLICATIONS	L	T	P	C		100
		3	0	0	3		
Course Objectives	- Explain 3D translation and orientation representation & illustrate the robot arm kinematics and use of robot operating system usage. - Classify the robot which meets kinematic requirements. - Apply localization and mapping aspects of mobile robotics. - Illustrate ROS applications. - Test robot programming.						

Unit-I	INTRODUCTION & MATERIAL HANDLING	(9)
Automation In Production System - Manual Labor in production systems -Principles and Strategies of Automation - Basic Elements of An Automated System - Levels of Automation - production concepts and mathematical models - Material Handling: Introduction to Material Handling- Material Handling Equipment's - Principles and Design Consideration in material handling Material Transport Equipment - Automated Storage systems		
Unit-II	FLUID POWER AND PNEUMATIC SYSTEMS	(9)
Introduction to Fluid power - Pascal's Law, Hydraulic Circuit Design and Analysis- Introduction - Control of A Single - Acting Hydraulic Cylinder Circuit - Control of a Double Acting Hydraulic Cylinder Circuit - Regenerative Cylinder Circuit. Basic Pneumatic systems: Types of Cylinders - Single acting Cylinder - Double acting Cylinder - Direction Control Valves- Valve position - Shuttle Valve		
Unit-III	MANUFACTURING SYSTEMS	(9)
Introduction to Manufacturing systems - Components of Manufacturing systems - Classification scheme for Manufacturing systems - Simple problems using Mathematic models of production performance - single station manufacturing cells - fundamentals of manual assembly lines		
Unit-IV	AUTOMATED PRODUCTION LINES AND ASSEMBLY SYSTEMS	(9)
Fundamentals of Automated Production Lines - Applications Of Automated production lines - System configurations - Work Part Transfer Mechanisms - Storage Buffers - Power Transmission Systems - Gears - Power Screws (Linear Guide ways)		
Unit-V	CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEMS	(9)
Introduction - Part Families - Manufacturing Cells - Cellular Manufacturing - Part classification and coding - Production Flow Analysis - Group Technology and its applications. Introduction to FMS - FMS Industrial Applications and its benefits - FMS components		
Total No of Periods to be Taught		45 Periods

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TEXT BOOK:

1	Automation, Production Systems and Computer Integrated Manufacturing- M. P. Groover, Pearson Education. Third edition/Fifth edition, 2009*.
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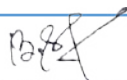
REFERENCES:

1	Fluid Power with Applications-Anthony Esposito, Peason, Sixth Addition.Edition
2	Pneumatic Systems, Principles and Maintenance- SR Majumdar, 2011 Edition.
3	Industrial Robotics, Technology, Programming, and applications- MikellP.Groover
4	Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
5	Engineering Metrology and Measurements -- N.V. Raghavendra, L.Krishnamurthy, 2018

COURSE OUTCOMES:

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

CO1:	Select & identify suitable automation hardware for the given understand application.
CO2:	Describe & explain potential areas of automation, material handling, Understand and Fluid power systems.
CO3:	Estimate of Manufacturing systems & Mathematical models of apply production lines
CO4:	Identify Industrial Automated production lines, work part transfer analyze mechanism and buffer storage analysis. Analyze Cellular Manufacturing, Flexible manufacturing Systems.
CO5:	planning implementation issues and implementation of quality Analyze programs in production systems.


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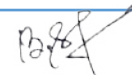
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Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	-	-	-	-	-	-	3	1	-
CO2	3	3	3	1	3	-	-	-	-	-	-	3	3	-
CO3	3	3	1	3	3	-	-	-	-	-	-	3	1	-
CO4	3	3	1	3	3	-	-	-	-	-	-	3	1	-
CO5	3	1	3	1	3	-	-	-	-	-	-	3	1	-
Avg.	3	1	3	2	3	-	-	-	-	-	-	3	1	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2407	INDUSTRIAL IOT	L 3	T 0	P 0	C 3	100
Course Objectives	- To understand the fundamentals of Internet of Things. - To learn about the basics of IOT protocols. - To build a small low cost embedded system using IoT. - To apply the concept of IOT in the real world scenario.					

Unit-I	INTRODUCTION AND ARCHITECTURE OF IoT	(9)
Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.		
Unit-II	INDUSTRIAL IoT	(9)
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking		
Unit-III	IIOT ANALYTICS	(9)
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop		
Unit-IV	IOT SECURITY	(9)
Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT		
Unit-V	CASE STUDY	(9)
Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017

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REFERENCES:

1	Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Cap
2	"Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

COURSE OUTCOMES:

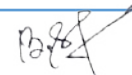
On completion of the course, the students will be able to

CO1:	Understand the basic concepts and Architectures of Internet of Things.
CO2:	Understand various IoT Layers and their relative importance.
CO3:	Realize the importance of Data Analytics in IoT.
CO4:	Study various IoT platforms and Security
CO5:	Understand the concepts of Design Thinking.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	-	2	3	2	2
CO2	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO3	3	2	2	2	2	2	-	-	-	-	2	3	3	2
CO4	3	2	3	2	3	2	-	-	-	-	2	3	3	2
CO5	3	3	3	3	3	3	-	-	-	-	1	3	2	3
Avg.	3	2.3	2.4	2.3	2	2.3	-	-	-	-	1.8	3	2.6	2.3

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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2408	SENSORS AND TRANSDUCERS	L 3	T 0	P 0	C 3	100
Course Objectives	The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.					

Unit-I	INTRODUCTION	(9)
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors –Sensor calibration techniques – Sensor Output Signal Types		
Unit-II	MOTION, PROXIMITY AND RANGING SENSORS	(9)
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)		
Unit-III	FORCE, MAGNETIC AND HEADING SENSORS	(9)
Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclonometers		
Unit-IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS	(9)
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure –Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors		
Unit-V	SIGNAL CONDITIONING AND DAQ SYSTEMS	(9)
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.

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2	Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
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REFERENCES:

1	Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2	John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

COURSE OUTCOMES:

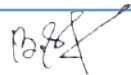
On completion of the course, the students will be able to

CO1:	List common types of sensor and actuators used in vehicles.
CO2:	Design measuring equipment's for the measurement of pressure force, temperature and flow
CO3:	Generate new ideas in designing the sensors and actuators for automotive application
CO4:	Understand the operation of the sensors, actuators and electronic control
CO5:	Design temperature control actuators for vehicles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO2	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO3	3	2	2	2	2	2	-	-	-	-	2	3	3	2
CO4	3	2	2	2	3	2	-	-	-	-	2	3	3	2
CO5	3	2	3	3	3	3	-	-	-	-	2	3	2	3
Avg.	3	2	2.3	2.3	2	2.3	-	-	-	-	2	3	2.8	2.3

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2409	SPACE SCIENCE	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To outline the space environment and their effects. • To extend the origin of universe and development. • To classify the galaxies and their evolution. • To interpret the variable stars in the galaxies. • To explain theory of formation of our solar system.					

Unit-I	INTRODUCTION	(9)
Introduction to space science and applications – historical development – Space Environment-Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Debris Environment and its Effects - Newton's Law of gravitation – Fundamental Physical Principles		
Unit-II	ORIGIN OF UNIVERSE	(9)
Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy		
Unit-III	GALAXIES	(9)
Galaxies, their evolution and origin – active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays		
Unit-IV	STARS	(9)
Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) – Chandrasekhar limit		
Unit-V	SOLAR SYSTEM	(9)
Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun – Bode's law – Kepler's Laws of planetary motion – Newton's deductions from Kepler's Laws – correction of Kepler's third law – determination of mass of earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets		
Total No of Periods to be Taught		45 Periods

TEXT BOOK:	
1	Hess W., "Introduction to Space Science", Gordon & Breach Science Pub; Revised Ed., 1968

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2	Krishnaswami K. S., “Astrophysics: A modern Perspective”, New Age International, 2006.
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REFERENCES:

1	Arnab Rai Choudhuri, “Astrophysics for Physicists”, Cambridge University Press, New York, 2010.
2	Krishnaswami K. S., “Understanding cosmic Panorama”, New Age International, 2008.

COURSE OUTCOMES:

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

CO1:	Obtain a broad, basic knowledge of the space sciences.
CO2:	Explain the scientific concepts such as evolution by means of natural selection, age of the Earth and solar system and the Big-Bang.
CO3:	Describe the main features and formation theories of the various types of observed galaxies, in particular the Milky Way.
CO4:	Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories;
CO5:	Describe the presently accepted formation theories of the solar system based upon observational and physical constraints.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	-	1	-	1	3	3	3
CO2	3	2	2	3	2	3	-	-	-	-	1	3	3	3
CO3	3	3	3	2	1	3	-	-	-	-	1	3	3	3
CO4	3	3	2	3	2	3	-	-	-	-	1	3	3	3
CO5	3	2	3	2	2	1	-	-	-	-	1	3	3	3
Avg.	3	2.3	2.3	2.3	2	2.3	1	-	1	-	1	3	3	3

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Department	Mechanical	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2401	REVERSE ENGINEERING	L	T	P	C	100
		2	0	2	3	
Course Objectives	• To Applying the fundamental concepts and principles of reverse engineering in product design and development. • Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development. • Applying the concept and principles of material identification and process verification in reverse engineering of product design and development. • Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development. • Analyzing the various legal aspect and applications of reverse engineering in product design and development.					

Unit-I	INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM	(6)
Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.		
Unit-II	MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION	(6)
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure		
Unit-III	MATERIAL IDENTIFICATION AND PROCESS de VERIFICATION	(6)
Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.		
Unit-IV	DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY	(6)
Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.		
Unit-V	ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF REVERSE ENGINEERING	(6)
Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials – Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Reverse Engineering, Kathryn, A. Ingle, McGraw-Hill, 1994
2	Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996

REFERENCES:

1	Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association
2	Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
3	Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
4	White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994

List of Exercises/Experiments

1.	Study of reverse engineering concepts, workflow, and industrial applications.
2.	Measurement of engineering components using Vernier caliper, micrometer, and height gauge.
3.	Hardness testing of engineering materials using Rockwell/Brinell methods.
4.	Study of creep and stress rupture characteristics of materials.
5.	3D Laser scanning of components.
6.	Reverse engineering of Automotive components-cam shaft.
7.	Material identification and process verification of welded components.
8.	Preparation of technical inspection and data analysis reports.
9.	Case study on reverse engineering applications in automotive systems.
10.	Reverse engineering of dental components - Bio medical applications.
Total No of Periods to be Taught	
30	


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COURSE OUTCOMES:

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

CO1:	Apply the fundamental concepts and principles of reverse engineering in product design and development.
CO2:	Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
CO3:	Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
CO4:	Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
CO5:	Analyze the various legal aspect and applications of reverse engineering in product design and development

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Vernier caliper	05 Each
2.	Micrometer	05 Each
3.	Height Gauge with Surface Plate	05 Each
4.	Rockwell Hardness Testing Machine	01 No
5.	Brinell Hardness Testing Machine	01 No
6.	Tool Maker Microscope	01 No
7.	Reverse Engineering software and 3D Modeling software	15 License
8.	3D Printer (FDM Type)	01 No
9.	3D Laser Scanner	01 No
10.	Surface Roughness Tester	01 No

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	1	2	-	1	-	-	-	-	-	-	-	-
CO4	3	3	1	2	-	1	-	-	-	-	-	-	-	-
CO5	1	2	1	1	-	1	-	-	-	-	-	-	-	-
Avg.	3	2	1	1	-	-	-	-	-	-	-	-	-	-

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Department	Mechanical	Programme Code & Name	Open to all departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2402	NON DESTRUCTIVE TESTING	L	T	P	C	100
		2	0	2	3	
Course Objectives	- Understanding the basic importance of NDT in quality assurance. - Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards. - Equipping themselves to locate a flaw in various materials, products. - Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards. - Acquiring the knowledge on the selection of the suitable NDT technique for a given application.					
Unit-I	INTRODUCTION TO NDT & VISUAL TESTING					(6)
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.						
Unit-II	LIQUID PENETRANT & MAGNETIC PARTICLE TESTING					(6)
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.						
Unit-III	EDDY CURRENT TESTING & THERMOGRAPHY					(6)
Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.						
Unit-IV	ULTRASONIC TESTING & AET					(6)
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.						
Unit-V	RADIOGRAPHY TESTING					(6)
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.						
Total No of Periods to be Taught		30				


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TEXT BOOK:

1	Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2	J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw Hill Education, 2nd edition, 2011.

REFERENCES:

1	ASM Metals Handbook, V-17, "Non-destructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2	Barry Hull and Vernon John, "Non-destructive Testing", Macmillan, 1989.
3	Chuck Hellier, "Handbook of Non-destructive Evaluation", Mc Graw Hill, 2012.
4	Louis Cartz, "Non-destructive Testing", ASM International, USA, 1995.

List of Exercises/Experiments

1. Conducting experiment using liquid penetrant testing.	
2. Study of lighting conditions and their effect on defect visibility.	
3. Conducting experiment using magnetic particle testing.	
4. Study of demagnetization techniques and evaluation of indications.	
5. Conducting experiment using ultrasonic testing.	
6. Study of A-scan, B-scan, and C-scan presentations.	
7. Conducting experiment using electromagnetic testing.	
8. Study of Eddy Current Sorter	
9. Conducting experiment using acoustic emission testing.	
10. Study of inverse square law and exposure charts.	
Total No of Periods to be Taught	30


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COURSE OUTCOMES:

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

CO1:	Realize the importance of NDT in various engineering fields.
CO2:	Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
CO3:	Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
CO4:	Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
CO5:	Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Dye penetrant kits.	01 No
2.	Test specimens with surface cracks.	02 Nos
3.	Ultrasonic flaw detectors.	01 No
4.	Eddy current instruments.	01 No
5.	Magnetic Particle Testing Instruments.	01 No

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	2	2	-	-	2	1	2	-
CO2	3	1	2	2	-	-	2	2	-	-	2	2	2	1
CO3	3	2	1	2	-	-	2	2	-	-	2	2	2	-
CO4	3	1	2	2	-	-	2	2	-	-	2	2	2	2
CO5	3	2	2	2	-	-	2	2	-	-	2	2	2	1
Avg.	2.8	1.6	1.8	2.2	-	-	2	2	-	-	2	1.8	2	1.3

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Department	Mechanical	Programme Code & Name	Open to all departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2403	ADDITIVE MANUFACTURING TECHNOLOGY	L	T	P	C	100
		2	0	2	3	
Course Objectives	• To introduce the development of Additive Manufacturing (AM), various business opportunities and applications • To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM. • To be acquainted with vat polymerization and direct energy deposition processes • To be familiar with powder bed fusion and material extrusion processes. • To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes					

Unit-I	INTRODUCTION	(6)
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing-Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.		
Unit-II	DESIGN FOR ADDITIVE MANUFACTURING (DfAM)	(6)
Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.		
Unit-III	VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION	(6)
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery -Materials -Benefits -Applications.		
Unit-IV	POWDER BED FUSION AND MATERIAL EXTRUSION	(6)
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.		
Unit-V	OTHER ADDITIVE MANUFACTURING PROCESSES	(6)
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.		
Total No of Periods to be Taught		30


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TEXT BOOK:

1	Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2	Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1	Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati, Ohio, 2011, ISBN :9783446425521.
2	Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3	Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4	Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
5	Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.

List of Exercises/Experiments

1. Modelling and converting CAD models into STL file.	
2. Manipulation and error fixing of STL file.	
3. Design and fabrication of parts by varying part orientation and support structures.	
4. Fabrication of parts with material extrusion AM process.	
5. Fabrication of parts with vat polymerization AM process.	
6. Design and fabrication of topology optimized parts.	
7. Extrusion based AM machine	
8. Resin based AM machine	
9. Mechanical design software	
10. Open-source AM software for STL editing, manipulation and slicing	
Total No of Periods to be Taught	30


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COURSE OUTCOMES:

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

CO1:	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2:	Acquire knowledge on process of transforming a concept into the final product in AM technology.
CO3:	Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4:	Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5:	Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Workstations	15 Nos
2.	FDM - 3D printers	01 No
3.	SLA/DLP resin printers	01 No
4.	Mechanical design software (Solid Edge, Solidworks)	15 License
5.	Hybrid AM machines	01 No

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	-	-	-	1	1	3	2
CO2	2	1	3	1	-	-	-	-	-	-	1	1	3	2
CO3	2	1	3	1	-	-	-	-	-	-	1	1	3	2
CO4	2	1	3	1	-	-	-	-	-	-	1	1	3	2
CO5	2	1	3	1	-	-	-	-	-	-	1	1	3	2
Avg.	2	1	3	1	-	-	-	-	-	-	1	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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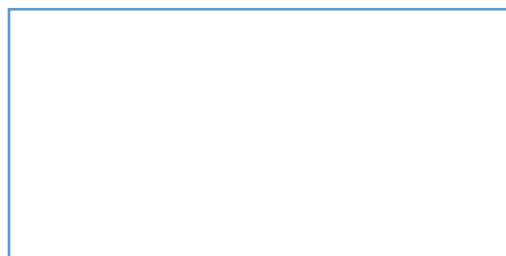
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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2404	ENERGY TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce students to the basic principles, characteristics, and importance of renewable energy sources, highlighting their differences compared to conventional fossil fuels. - To prepare students for careers in energy engineering by equipping them with technical knowledge, analytical skills, and practical exposure to renewable energy systems. - To enable students to compare and evaluate different renewable energy technologies, selecting the most suitable options based on local resources, environmental conditions, and economic feasibility. - To explain the scientific and engineering principles behind harnessing renewable energy sources such as solar, wind, biomass, hydro, and emerging technologies. - To develop the ability to critically assess current developments, innovations, and future directions in renewable energy, fostering advanced technical understanding of global energy challenges.					
Unit-I	INTRODUCTION					(9)
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources						
Unit-II	CONVENTIONAL ENERGY					(9)
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.						
Unit-III	NON-CONVENTIONAL ENERGY					(9)
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrius rotor and Gravina rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.						
Unit-IV	BIOMASS ENERGY					(9)
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.						
Unit-V	ENERGY CONSERVATION					(9)
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.						
Total No of Periods to be Taught		45				





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TEXT BOOK:

1	Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2	Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3	Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4	Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES:

1	Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2	El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3	Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

COURSE OUTCOMES:

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

CO1:	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2:	Students will excel as professionals in the various fields of energy engineering
CO3:	Compare different renewable energy technologies and choose the most appropriate based on local conditions
CO4:	Explain the technological basis for harnessing renewable energy sources.
CO5:	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	1	1	-	3	1	1	3
CO2	2	3	1	3	3	-	-	1	1	-	3	2	1	3
CO3	2	2	2	3	3	1	-	1	1	-	3	2	1	3
CO4	2	2	1	3	3	1	1	1	-	1	3	1	1	3
CO5	2	2	1	3	3	1	1	1	-	1	3	2	1	3
Avg.	2	2	1	3	3	2	1	1	1	1	3	2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2405	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To know the Indian and global energy scenario - To learn the various solar energy technologies and its applications. - To educate the various wind energy technologies. - To explore the various bio-energy technologies. - To study the ocean and geothermal technologies					

Unit-I	ENERGY SCENARIO	(9)
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans		
Unit-II	SOLAR ENERGY	(9)
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.		
Unit-III	WIND ENERGY	(9)
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications		
Unit-IV	BIO-ENERGY	(9)
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration – Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.		
Unit-V	OCEAN AND GEOTHERMAL ENERGY	(9)
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Fundamentals and Applications of Renewable Energy Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636	
2	Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707.	


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REFERENCES:

1	Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2	Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3	Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4	Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5	Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015

COURSE OUTCOMES:

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

CO1:	Discuss the Indian and global energy scenario.
CO2:	Describe the various solar energy technologies and its applications.
CO3:	Explain the various wind energy technologies
CO4:	Explore the various bio-energy technologies.
CO5:	Discuss the ocean and geothermal technologies

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	3	2	2	1	1	2	1	2
CO2	3	2	2	1	1	1	3	1	1	1	2	2	1	2
CO3	3	2	3	1	2	1	3	1	1	1	1	1	1	2
CO4	2	2	2	1	2	1	3	1	1	1	2	2	2	2
CO5	2	1	2	1	2	1	3	1	1	1	1	2	1	2
Avg.	3	2	2	1	2	1	3	1	1	1	1	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy


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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2406	INTRODUCTION TO INDUSTRIAL ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the concepts productivity and productivity measurement approaches. - Understand the basic principles in facilities planning and plant location - Apply work study and ergonomic principles to design workplaces for the improvement of human performance - Impart knowledge to design and implement Statistical Process control in any industry - Recognize the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages					
Unit-I	INTRODUCTION					(9)
Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures						
Unit-II	PLANT LOCATION AND LAYOUT					(9)
Factors affecting Plant location – course objectives of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.						
Unit-III	WORK SYSTEM DESIGN& ERGONOMICS					(9)
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.						
Unit-IV	STATISTICAL QUALITY CONTROL					(9)
Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling- O.C curve –Single sampling plan- Double sampling plan						
Unit-V	PRODUCTION PLANNING AND CONTROL					(9)
Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity– Loading – Scheduling and control of production – Dispatching–Progress contro						
Total No of Periods to be Taught		45				

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TEXT BOOK:

1	O.P.Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications.
2	Koontz.H.andWeihrich.H.,“EssentialsofManagement:AnInternationalPerspective”,8th Edition, Tata McGraw-Hill, New Delhi, 2010.

REFERENCES:

1	Ravi Shankar, 2009, Industrial Engineering and Management, Galgotia Publications & Private Limited.
2	Martand Telsang,2006, Industrial Engineering and Production Management, S. Chand and Company

COURSE OUTCOMES:

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

CO1:	Ability To define the concepts of productivity and productivity measurement approaches.
CO2:	Ability to evaluate appropriate location models for various facility types and design various facility layouts
CO3:	To conduct a method study and time study to improve the efficiency of the system.
CO4:	Ability to Control the quality of processes using control charts in manufacturing/service industries.
CO5:	Ability to define the Planning strategies and Material Requirement Plan.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	1	-	-	2	-	-	1	2	-	-
CO4	2	2	3	1	1	-	-	-	-	-	-	-	-	-
CO5	1	2	2	-	-	-	-	-	-	-	-	-	-	3
Avg.	2.2	2	2.5	1.3	1	-	-	2	-	-	1	2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy


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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2407	FIBRE REINFORCED PLASTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the basic definition and unique properties of nanomaterials arising from size effects. - Explore various synthesis methods for fabricating nanomaterials using top-down and bottom-up approaches. - Study the types and properties of nanocomposites, and the role of interface, shape, and structure in determining their behavior. - Familiarize with classification schemes and characterization techniques such as spectroscopy, diffraction, thermal analysis, and surface area measurements. - Evaluate the diverse and emerging applications of nanomaterials in electronics, medicine, energy, coatings, and environmental technologies.					
Unit-I	INTRODUCTION					(9)
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis						
Unit-II	SYNTHESIS OF NANOMATERIALS					(9)
Bottom up and Top-down approach for obtaining nano materials – Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.						
Unit-III	NANO COMPOSITES					(9)
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.						
Unit-IV	NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES					(9)
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.						
Unit-V	APPLICATIONS OF NANO MATERIALS					(9)
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.						
Total No of Periods to be Taught		45				


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TEXT BOOK:

1	Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, “ Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas PressG.
2	Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications” Imperial College Press, 2004

REFERENCES:

1	R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.
2	C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3	Ivor Brodie and Julius J.Muray, 'The physics of Micro/Nano – Fabrication', Springer International Edition, 2010

COURSE OUTCOMES:

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

CO1:	Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications
CO2:	Able to acquire knowledge about the different types of nano material synthesis
CO3:	Describes about the shape, size, structure of composite nano materials and their interference
CO4:	Understand the different characterization techniques for nano materials
CO5:	Develop a deeper knowledge in the application of nano materials in different fields.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	-	1	1	-	1	1	3
CO2	2	3	1	3	3	-	-	-	1	1	-	2	1	3
CO3	2	2	2	3	3	1	1	-	1	1	-	2	1	3
CO4	2	2	1	3	3	1	1	1	1	-	1	1	1	3
CO5	2	2	1	3	3	1	1	1	1	-	1	2	1	3
Avg.	3	2	2	1	3	3	1	1	1	1	1	3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2408	NANO TECHNOLOGY AND ITS APPLICATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the basic concepts, structures, and kinetics of nanoparticles and nanostructured materials. - To provide knowledge of synthesis methods and characterization techniques for nanomaterials. - To understand the optical, electrical, and mechanical properties of nanomaterials and their measurement methods. - To explore different nanostructures and their applications in engineering, medicine, and materials science. - To explain the role of nanotechnology in electronics, sensors, diagnostics, environment, agriculture, and energy systems.					

Unit-I	INTRODUCTION TO NANOTECHNOLOGY	(9)
Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero-dimensional, size and shape of nanoparticles; one-dimensional and two-dimensional nanostructures- clusters of metals and semiconductors, bio nano-particles.		
Unit-II	FABRICATION AND CHARACTERIZATION OF NANOMATERIALS	(9)
Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.		
Unit-III	PROPERTIES AND MEASUREMENT OF NANOMATERIALS	(9)
Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.		
Unit-IV	NANO STRUCTURES	(9)
Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.		
Unit-V	APPLICATIONS OF NANOTECHNOLOGY	(9)
Nano electronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)
2	Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)

REFERENCES:

1	Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2	Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3	Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

COURSE OUTCOMES:

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

CO1:	Describe the fundamentals and structural characteristics of nanoparticles and nanostructures.
CO2:	Demonstrate knowledge of fabrication techniques and characterization tools for nanomaterials.
CO3:	Analyze the properties of nanomaterials using advanced measurement methods.
CO4:	Evaluate the applications of nanostructures in ceramics, drug delivery, magnetoresistance, and biological systems.
CO5:	Apply nanotechnology concepts to electronics, sensors, diagnostics, environmental, agricultural, and energy systems.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	1	2	1	1	1	1	3	2	2
CO2	3	3	2	3	3	2	2	1	2	2	2	3	2	2
CO3	3	3	2	3	3	2	2	1	2	2	2	3	2	2
CO4	3	3	3	3	3	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	3	3	2	2	2	2	2	3	3
Avg.	3	3	2.2	2.8	2.8	2	2.4	1.4	1.8	1.8	1.8	2.6	2.4	2.2

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2401	ARCHITECTURAL HERITAGE OF INDIA	L	T	P	C	100
		3	0	0	3	
Course Objectives	● To help students understand the history and styles of Indian architecture. ● To create awareness about preserving India’s architectural heritage.					

Unit-I	INDUS VALLEY CIVILIZATION	(9)
Indus valley civilization – Chronological introduction – Construction style – Materials used – The cities Harappa, lothal and Mohenjo-Daro, The great bath – The granary at Harappa – The assembly hall – Ajanta-Ellora Cave temples – Mahabodhi temple complex		
Unit-II	SOUTH INDIAN ARCHITECTURE	(9)
Chera-Chola-Pandya architecture – Chronological introduction – Construction style – Materials used – Brihadeeswarar Temple – Meenakshi Temple – Kalinga – Chalukya – Pallava architecture – Mahabalipuram stone temples – Khajuraho – Muskin Bhanvi – Konark Sun Temple – Hoysala – Vijayanagara architecture – twin temples Mosale – Virupaksha temple Raya Gopura at Hampi		
Unit-III	MUGHAL ARCHITECTURE	(9)
Mughal architecture – Chronological introduction – Construction style – Materials used – Qutub Minar – Taj Mahal – Humayun's Tomb – Redfort – Fatehpur Sikri – Agra fort – Jama Masjid – Rajput civil architecture – Chronological introduction – Construction style – Materials used – All hill forts of Rajasthan		
Unit-IV	BRITISH ARCHITECTURE	(9)
British colonial architecture – Chronological introduction – Construction style – Materials used – Buildings in Chennai, Mumbai, Shimla – Churches – Mountain railways of India-bridges.		
Unit-V	COLONIAL ARCHITECTURE	(9)
Other colonial architecture – Portuguese-Dutch-French-Danish – Chronological introduction – Construction style – Materials used – Churches – Churches and Convents of Goa and Cochi – French town of Puducherry – Tranquebar fort – Bungalow on the beach		
Total No of Periods to be Taught		45 periods

TEXT BOOK:	
1	Bindia Thapar, Surat Kumar Manto, and Suparna Bhalla., Introduction to Indian Architecture: Arts of Asia, Periplus Editions (HK) Ltd, Hong Kong, First Edition, 2005
2	Sandhya Ketkar., The History of Indian Art, Jyotsna Prakashan Publisher, Maharashtra, E – Edition, 2020



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REFERENCES:

1	Christopher Tadgell., The History of Architecture in India, Phaidon Press Ltd, New York, First Edition, 1990
2	Mark M. Jarzombek, Vikramaditya Prakash, Francis D. K. Ching., A Global History of Architecture, John Wiley & Sons, Hoboken, Second Edition, 2010
3	https://nptel.ac.in/courses/124106009
4	https://ncert.nic.in/textbook/pdf/kefa106.pdf

COURSE OUTCOMES:

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

CO1:	Illustrate various materials used and construction style of Indus Valley Civilization
CO2:	Demonstrate the materials used and construction style of Chera, Chola and Pandya architecture
CO3:	Describe the materials used and construction style of Mughal architecture
CO4:	Explain the various materials and construction style of British architecture
CO5:	Describe various materials and construction style of Portuguese, Dutch, French and Danish

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	2	-	-	-	-	3	-	-	-
CO2	3	3	-	2	-	2	-	-	-	-	3	-	-	-
CO3	3	3	-	1	-	2	-	-	-	-	3	-	-	-
CO4	3	3	-	2	-	2	-	-	-	-	3	-	-	-
CO5	3	3	-	1	-	2	-	-	-	-	3	-	-	-
Avg.	3	3	-	2	-	2	-	-	-	-	3	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2402	BUILDING PLANNING AND CONSTRUCTION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To teach the basic principles of building planning and design. • To provide knowledge about construction methods and materials.					

Unit-I	FUNCTIONAL PLANNING OF BUILDINGS	(9)
Types of Buildings, Aspects and Principles of Building Planning, Building By - laws and Regulations, Site Selection criteria, Orientation of Building and its relation to surrounding environment, Sustainability and Green Buildings - Building Bye - laws and Building code of India 2016.		
Unit-II	BUILDING COMPONENTS AND FOUNDATIONS	(9)
Lintels, arches, different types of floors-concrete, mosaic, terrazzo floors, pitched, flat and curved roofs, lean-to roof, coupled roofs, trussed roofs, king and queen post trusses; RCC roofs, madras terrace/shell roofs. Foundations: Shallow foundations, spread, combined, strap and mat footings.		
Unit-III	ALTERNATIVE MATERIALS AND MASONRY	(9)
Structure, properties, seasoning of timber; Classification of various types of woods used in buildings, defects in timber; Alternative materials for wood, galvanized iron, fibre-reinforced plastics, steel, aluminium and glass; Types of masonry, English and Flemish bonds, rubble and ashlar masonry, cavity and partition walls - Light weight concrete blocks – merits and demerits.		
Unit-IV	FLOORS, ROOFS AND STAIRCASES	(9)
Components of a floor, materials used for floor construction, Different types of flooring, Ground floor and upper floors, Types of roofs, Basic roofing elements and Roof coverings. Functional requirements of a good stair, type of stairs, planning a stair case.		
Unit-V	DAMP PROOFING AND FIRE PROTECTION	(9)
Damp proofing and Fire protection: Causes and effect of dampness on buildings, Materials and methods used for damp proofing, Fire hazards, Grading of buildings according to fire resistance, Fire resisting properties of common building materials, Fire resistant construction.		
Total No of Periods to be Taught		45 periods

TEXT BOOK:	
1	Varghese P. C., Building construction, PHI Learning Pvt. Ltd, New Delhi ,Second Edition, 2016.
2	B. C. Punmia , Ashok Kumar Jain, Arun Kumar Jain, Building Construction, Laxmi Publications, New Delhi, Eleventh Edition,2019.



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REFERENCES:

1	S. K. Duggal, Building Materials , New Age International (P) Limited, New Delhi ,Fourth Edition, 2016,
2	Bulding Bye-laws 2019
3	National Building Code of India, 2016.
4	www.nptel.ac.in/courses/105101088/2 home.htm

COURSE OUTCOMES:

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

CO1:	Outline the factors to be considered in planning and construction of buildings
CO2:	Infer the different components and Foundations of building in their construction practices.
CO3:	Interpret masonry and alternative materials of wood, aluminum and glass.
CO4:	Discuss different types of floors, roofs and the materials which are commonly used for construction.
CO5:	Explain about dampness and fire resistance in buildings

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	3	-	-	-	-	2	-	-	-
CO2	3	2	-	2	-	3	-	-	-	-	2	-	-	-
CO3	2	-	-	2	-	3	-	-	-	-	2	-	-	-
CO4	3	2	-	2	-	3	-	-	-	-	2	-	-	-
CO5	3	2	-	2	-	3	-	-	-	-	2	-	-	-
Avg.	3	2	1	2	-	3	-	-	-	-	2	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy



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Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2403	ELEMENTARY CIVIL ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce the fundamental concepts and branches of civil engineering. • To create awareness about basic materials, tools, and construction practices.					

Unit-I	OVERVIEW OF CIVIL ENGINEERING	(9)
History of Civil Engineering - Role and Functions of Civil Engineer - Fields of Civil Engineering - Importance of Civil Engineering		
Unit-II	BASICS OF SURVEYING	(9)
Introduction - Basic Definitions (Surveying, leveling, Plans, Maps, Scales) - Introduction to divisions of surveying - Classification of surveying - Fundamental principles of surveying - Measurement in Surveying - Phases of Surveying MODERN TOOLS OF SURVEYING AND MAPPING: Introduction to Global Positioning System - Remote Sensing and Geographic Information System		
Unit-III	FUNDAMENTALS OF BUILDING MATERIALS	(9)
Bricks – stones – sand – M-sand - cement – fly ash - silica fume - mortar- concrete – steel – glass - wood plastics – ceramics		
Unit-IV	COMPONENTS OF BUILDING	(9)
Foundations – stone masonry – brick masonry – beams – columns – lintels – roofing – flooring – plastering- damp proofing weathering course		
Unit-V	STRUCTURES	(9)
Introduction to dams, weirs, barrages and check dams - Role of transportation in national development - Modes of transportation - Introduction to road traffic and traffic control - Introduction to mass transportation system		
Total No of Periods to be Taught		45 periods

TEXT BOOK:	
1	Anurag Kandya, Elements of Civil Engineering, Charotar Publishing House Pvt. Ltd, Gujarat, Third Edition, 2017.
2	Palanichamy M.S., Basic Civil Engineering, Tata McGraw-Hill, New Delhi, Fourth Edition, 2011.



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REFERENCES:

1	Poonam Sharma & Swati Rajput, Sustainable Smart Cities in India – Challenges and Future Perspectives, Springer, First Edition, 2017.
2	Dr.B.C.Punamia, Surveying, Laxmi Publication, New Delhi, Seventh Edition, 2016.
3	https://nptel.ac.in/courses/105102088
4	https://byjusexamprep.com/civil-engineering-exams/building-materials

COURSE OUTCOMES:

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

CO1:	Provide an overview of civil engineering
CO2:	Explain the basics of surveying , modern tools of surveying and mapping
CO3:	Summarize the fundamentals of building materials in civil engineering
CO4:	Explain the components of building structures.
CO5:	Interpret various infrastructures of civil engineering in construction

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	1	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	2	-	-	-	-	1	-	-	-
CO3	2	1	-	-	-	2	-	-	-	-	1	-	-	-
CO4	2	1	-	-	-	2	-	-	-	-	1	-	-	-
CO5	3	2	1	-	-	3	-	-	-	-	1	-	-	-
Avg.	3	2	1	-	-	3	-	-	-	-	1	-	-	-

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Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2404	ENERGY AND ENVIRONMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	● To provide basic knowledge about different energy sources and their uses. ● To create awareness about environmental issues and sustainable practices.					

Unit-I	INTRODUCTION	(9)
Overview on the Earth's energy requirements-Climate Change-Origins of the terrestrial atmosphere-Earth's early atmosphere- Introduction to Climate-Layers of the atmosphere.		
Unit-II	GLOBAL ATMOSPHERIC ISSUES	(9)
Composition of the present day atmosphere-Introduction to Atmospheric chemistry-Green House Gases, and the O3 - depletion problem-Post Industrial Revolution Scenario		
Unit-III	ENERGY BALANCE	(9)
Earth Atmosphere System- Solar and Terrestrial Radiation- Absorption of Radiation by gases.-Energy balance- Solar variability and the Earth's Energy Balance.		
Unit-IV	ATMOSPHERIC CHEMISTRY AND CLIMATE	(9)
The Global Temperature Record.-Possible effects of Global Warming. – Indian Context. Atmospheric Chemistry and Climate Change- Atmospheric Aerosol and Cloud Effects on Climate.		
Unit-V	ENVIRONMENTAL VARIABILITY	(9)
Natural (volcanoes, forest fires) and Anthropogenic (Antarctic Ozone Hole, Global Warming).-Green House Gas theory.- Effects of urbanization- Landscape changes-Influence of Irrigation-Desertification and Deforestation		
Total No of Periods to be Taught		45 periods

TEXT BOOK:	
1	Peter E Hodgson, Energy the Environment and Climate Change, Imperial College Press, London, First Edition, 2010
2	Ahluwalia V K, Energy and Environment, The Energy and Resources Institute, New Delhi, First Edition, 2019



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REFERENCES:

1	Richard Wolfson, Energy, Environment, and Climate, Publisher: W. W. Norton & Company, New York, Second Edition, 2011
2	Saeed Moaveni, Energy, Environment, and Sustainability with Mind Tap, Cengage India Private Limited, New Delhi, First Edition, 2017
3	Wilbanks, T., Bilello D, Schmalzer D, Scott, Climate Change and Energy Supply and Use: Technical Report for the U.S. Department of Energy in Support of the National Climate Assessment., Island Press, Washington, 2013
4	Frank T. Princiotta, Global Climate Change - The Technology Challenge, Springer Publisher, New York, First Edition, 2011

COURSE OUTCOMES:

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

CO1:	Outline the earth's energy, environment and the processes leading to climate change
CO2:	Infer the atmospheric issues related to the chemistry, green house gases
CO3:	Summarize the role of the terrestrial energy-environment-climate system
CO4:	Interpret the Possible effects of Global Warming and climate change.
CO5:	Outline the Natural and Anthropogenic and Green House Gas theory

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	2	-	-	-	-	2	-	-	-
CO2	3	3	-	-	-	2	-	-	-	-	2	-	-	-
CO3	3	3	-	-	-	2	-	-	-	-	2	-	-	-
CO4	3	3	-	-	-	2	-	-	-	-	2	-	-	-
CO5	3	3	1	-	-	2	-	-	-	-	2	-	-	-
Avg.	3	3	1	-	-	2	-	-	-	-	2	-	-	-

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Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2405	GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To explain the causes and effects of global warming and climate change. • To promote awareness of mitigation strategies and sustainable solutions.					

Unit-I	EARTH'S CLIMATE SYSTEM	(9)
Role of ozone in environment – Ozone layer – Ozone depleting gases – Greenhouse gases and its sources – Green House Effect, Radiative Effects of Greenhouse Gases -The Hydrological Cycle – Green House Gases and Global Warming – Effects and causes of Global Warming, Carbon Cycle.		
Unit-II	ATMOSPHERE AND ITS COMPONENTS	(9)
Importance of Atmosphere – Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere - Composition of the atmosphere - Atmospheric stability -Temperature profile of the atmosphere - Lapse rates- Temperature inversion - effects of inversion on pollution dispersion.		
Unit-III	OBSERVED CHANGES AND ITS CAUSES	(9)
Causes of Climate change – Change of Temperature in the environment - Melting of ice Pole-sea level rise - Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.		
Unit-IV	OBSERVED CHANGES AND ITS CAUSES	(9)
Climate change and Carbon credits – CDM- Initiatives in India - Kyoto Protocol - Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India		
Unit-V	CLIMATE CHANGE AND MITIGATION MEASURES	(9)
Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding - Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste(MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.		
Total No of Periods to be Taught		45 periods



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TEXT BOOK:

1	Kandarp Tarkeshprasad Vaishnav., Climate Change Solutions, Global Warming Solutions & Innovative Ideas For Construction of World Development, Notion Press, Chennai, First Edition, 2018
2	Vivian Moritz., Climate Change and Global Warming, Syrawood Publishing House, New York, First Edition, 2017

REFERENCES:

1	Marie Antonette and Chloe Marechal., Climate Change Past, Present & Future, Wiley-Blackwell, New Jersey, First Edition, 2015.
2	Empereur Raymond., Global Warming and Climate Change, Litfire Publishing, Atlanta, First Edition, 2017.
3	Agarwal S.K., Global Warming and Climate Change Past, Present & Future, Ashish Publishing House, New Delhi, First Edition, 2004.
4	https://onlinecourses.swayam2.ac.in/arp19_ap55/preview

COURSE OUTCOMES:

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

CO1:	Outline the concept of the causes and effects of global warming
CO2:	Summarize about physical and chemical characteristics of atmosphere
CO3:	Identify the causes and effects of climate change
CO4:	Infer the agreements took place among the countries regarding climate change
CO5:	Summarize about the concept of mitigation measures against climate change

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	3	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	-	-	-	2	2	-	-	-
CO3	3	-	-	2	-	3	-	-	-	2	3	-	-	-
CO4	3	2	-	2	-	3	-	2	-	-	2	-	-	-
CO5	3	2	-	-	-	3	-	3	-	2	3	-	-	-
Avg.	3	2	2	2	-	3	-	3	-	2	3	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Mecheri, Salem Dt-636453, Tamilnadu

Department	CIVIL	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCEOE2406	INTRODUCTION TO DISASTER MANAGEMENT AND MITIGATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	● Provide adequate knowledge about disaster mitigation, preparedness, response, and recovery to face disaster among government bodies, institutions, N O's, etc. ● Obtain the knowledge different disaster and its preparedness and mitigation methods. ● Provide adequate knowledge about applications of space technology in disaster monitoring and information dissemination					

Unit-I	INTRODUCTION TO DISASTER	(9)
Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change		
Unit-II	NATURAL DISASTER AND MANMADE DISASTERS	(9)
Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion. Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.		
Unit-III	DISASTER MANAGEMENT CYCLE AND FRAMEWORK	(9)
Disaster Management Cycle, Paradigm Shift in Disaster Management Pre-Disaster Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development, Awareness During Disaster Evacuation, Disaster Communication, Search and Rescue, Emergency Operation Centre, Incident Command System, Relief and Rehabilitation, Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery, Reconstruction and Redevelopment, IDNDR, Yokohama Strategy, Hyogo Framework of Action.		
Unit-IV	DISASTER MANAGEMENT IN INDIA DISASTER PROFILE OF INDIA	(9)
Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005, Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management, Role of Government, Non-Government and Inter-Governmental Agencies.		
Unit-V	APPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DISASTER MANAGEMENT & MITIGATION	(9)
Geo-informatics in Disaster Management, Disaster Communication System, Land Use Planning and Development Regulations, Structural and Non Structural Mitigation of Disasters, S&T Institutions for Disaster Management in India.		
Total No of Periods to be Taught		45 periods



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TEXT BOOK:

1	R B Singh., Disaster Management and Mitigation, World focus Publisher, New Delhi, First Edition, 2016.
2	Satish Modh, Introduction to disaster management, Macmillan publishers India Ltd, New Delhi, Second Edition, 2019.

REFERENCES:

1	R B Singh., Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi, Reprint Edition, 2006.
2	Pardeep Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, Fourth Edition, 2018.
3	M. Saravanakumar, Disaster Management, Himalaya Publishing House, Bangalore, First Edition, 2017
4	Singh, Disaster Management: Future Challenges, IK International, New Delhi, First Edition, 2017.

COURSE OUTCOMES:

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

CO1:	Explain the concepts of disaster and its effect in Indian scenario.
CO2:	Elaborate the difference between natural and manmade disasters.
CO3:	Outline the disaster management cycle and its operation.
CO4:	Outline the disaster management in India and its profile
CO5:	Propose the application of geo-informatics for disaster management and mitigation.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	2	-	-	-	-	3	-	-	-
CO2	3	3	1	-	-	3	-	-	-	-	3	-	-	-
CO3	3	3	-	-	-	2	-	-	-	-	3	-	-	-
CO4	3	3	1	-	-	3	-	-	-	-	3	-	-	-
CO5	3	3	3	-	2	3	-	-	-	-	3	-	-	-
Avg.	3	3	1	-	2	3	-	-	-	-	3	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy



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Department		AGRI		Programme Code & Name				Open to All Departments	
Course Code	Course Name			Hours/Week		Credit	Maximum Marks		
UAIOE2401	INTRODUCTION TO FOOD PROCESSING			L	T	P	C	100	
				3	0	0	3		
Course Objectives									
The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.									
UNIT I		PROCESSING OF FOOD AND ITS IMPORTANCE						9	
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.									
UNIT II		METHODS OF FOOD HANDLING AND STORAGE						9	
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.									
UNIT III		LARGE-SCALE FOOD PROCESSING						9	
Milling of grains and pulses; edible oil extraction; Pasteurization of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.									
UNIT IV		FOOD WASTES IN VARIOUS PROCESSES						9	
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.									
UNIT V		FOOD HYGIENE						9	
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.									
Total								45 Periods	



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TEXT BOOK:

1 Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.

REFERENCES:

1 VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.

2 Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.

3 Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

COURSE OUTCOMES:

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

CO1: Be aware of the different methods applied to processing foods.

CO2: Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

CO3: Describe about large-scale food processing methods.

CO4: Distinguish Food Wastes in Various Processes techniques.

CO5: Understand the concepts of Food process methods, Storage techniques, food handling methods, reduces food waste and food hygiene process.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

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Department		AGRI		Programme Code & Name				Open to All Departments	
Course Code	Course Name			Hours/Week		Credit	Maximum Marks		
UAIOE2402	TRADITIONAL INDIAN FOODS	L	T	P	C	100			
		3	0	0	3				
Course Objectives									
To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.									
UNIT – I		HISTORICAL AND CULTURAL PERSPECTIVES						9	
Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditionson food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.									
UNIT II		TRADITIONAL METHODS OF FOOD PROCESSING						9	
Traditional methods of milling grains –rice, wheat and corn –equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sun drying, osmotic drying, brining, pickling and smoking.									
UNIT III		TRADITIONAL FOOD PATTERNS						9	
Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods									
UNIT IV		COMMERCIAL PRODUCTION OF TRADITIONAL FOODS						9	
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, butter milk, dahi. Commercial production of intermediate foods –ginger and garlic pastes, tamarind pastes, masalas (spicemixes), idli and dosa batters.									
UNIT V		HEALTH ASPECTS OF TRADIONAL FOODS						9	
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental cost soft raditional foods; traditional foods used for specific ailments /illnesses.									
Total								45 Periods	



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TEXT BOOK:

1	Sen, Colleen Taylor“ Food Culture in India” Green wood Press, 2005.
2	Davidar, Ruth N.“Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001

COURSE OUTCOMES:

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

CO1:	Provide a comprehensive understanding of the origins, evolution, and regional diversity of Indian cuisine.
CO2:	Highlight the traditional ingredients, cooking methods, and food preparation techniques used across various parts of India.
CO3:	Explore the cultural, religious, and seasonal influences on traditional Indian dietary practices.
CO4:	Analyze the nutritional and therapeutic value of traditional Indian foods and their relevance in modern diets.
CO5:	Introduce traditional food preservation methods like fermentation, pickling, drying, and smoking.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

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Department		AGRI		Programme Code & Name				Open to All Departments	
Course Code	Course Name			Hours/Week		Credit		Maximum Marks	
UAIOE2403	FUNDAMENTALS OF FOOD ENGINEERING			L	T	P	C	100	
				3	0	0	3		
Course Objectives									
- Acquaint and equip the students with different techniques of measurement of engineering properties. - Make the students understand the nature of food constituents in the design of processing equipment									
UNIT – I		ENGINEERING PROPERTIES OF FOOD MATERIALS						9	
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.									
UNIT II		DRYING AND DEHYDRATION IN FOOD PROCESSING						9	
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers.									
UNIT III		SIZE REDUCTION IN FOOD PROCESSING: PRINCIPLES, BENEFITS, ANALYSIS & EQUIPMENT						9	
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping).									
UNIT IV		MIXING IN FOOD AND CHEMICAL PROCESSING						9	
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder- liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.									
UNIT V		DOMESTIC UTILIZATION OF ELECTRICAL ENERGY						9	
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation : General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.									
Total								45 Periods	



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TEXT BOOK:

1	R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Institute of Food Science & Technology, Nz. Warren L. McCabe, Julian Smith, Peter Harriott. 2004.
2	Unit Operations of Chemical Engineering, 7 th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003.
	Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.

COURSE OUTCOMES:

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

CO1:	To understand the importance of food polymers
CO2:	To understand the effect of various methods of processing on the structure and texture of food materials
CO3:	To evaluate domestic wiring connection and debug any faults occurred.
CO4:	To understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.
CO5:	Promote awareness of the role of food engineering in ensuring food quality, safety, and sustainability.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

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Department		AGRI		Programme Code & Name				Open to All Departments	
Course Code	Course Name			Hours/Week		Credit	Maximum Marks		
UAIOE2404	REMOTE SENSING CONCEPTS			L	T	P	C	100	
				3	0	0	3		
Course Objectives									
- To introduce the concepts of remote sensing processes and its components. - To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation									
UNIT – I		REMOTE SENSING AND ELECTROMAGNETIC RADIATION						9	
Definition–components of RS – History of Remote Sensing –Merits and demerits of data collation between conventional and remote sensing methods Electromagnetic Spectrum– Radiation principles - Wave theory, Planck’s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff’s law – Radiation sources : active & passive - Radiation Quantities.									
UNIT II		EMRINTERACTION WITH ATMOSPHERE AND EARTH MATERIAL						9	
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectro radio meter–Spectral Signature concepts –Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.									
UNIT III		ORBITS AND PLATFORMS						9	
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler ‘s law of planetary motion - Orbit elements and types – Orbital per turbations and maneuvers–Types of remote sensing platforms- Ground based, Airborne platforms and Space borne platforms –Classification of satellites –Sun synchronous and Geosynchronous satellites – Lagrange Orbit.									
UNIT IV		SENSING TECHNIQUES						9	
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites									
UNIT V		DATA PRODUCTS AND INTERPRETATION						9	
Photographic and digital products –Types, levels and open source satellite data products – selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification									
Total								45 Periods	



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TEXT BOOK:

1	Thomas M. Lilles and, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2	George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018

COURSE OUTCOMES:

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

CO1:	Understand the concepts and laws related to remote sensing
CO2:	Understand the interaction of electromagnetic radiation with atmosphere and earth material.
CO3:	Acquire knowledge about satellite or bits and different types of satellites.
CO4:	Understand the different types of remote sensors.
CO5:	Gain knowledge about the concepts of interpretation of satellite imagery

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

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Department		AGRI		Programme Code & Name				Open to All Departments	
Course Code	Course Name			Hours/Week		Credit	Maximum Marks		
UAIOE2405	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT			L	T	P	C	100	
				3	0	0	3		
Course Objectives									
- To introduce the inter disciplinary approach of water management. - To develop knowledge base and capacity building on IWRM.									
UNIT – I		OVER VIEW OF INTEGRATED WATER RESOURCES MANAGEMENT						9	
Facts about water – Definition – Key challenges – Paradigm shift – Water management Principles – Social equity – Ecological sustainability – Economic efficiency - SDGs- World Water Forums.									
UNIT II		WATER USE SECTORS : IMPACTS AND SOLUTION						9	
Water users : People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources -Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.									
UNIT III		WATER ECONOMICS						9	
Economic characteristics of water good and services –Economic instruments –Private sector involvement in water resources management - PPP experiences through case studies.									
UNIT IV		RECENTTRE AND SIN WATER MANAGEMENT						9	
Riverbasin management - Ecosystem Regeneration –5 Rs - WASH – Sustainable livelihood – Water management in the context of climate change.									
UNIT V		IMPLEMENTATION OF IWRM						9	
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.									
Total								45 Periods	

TEXT BOOK:

1	Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2	Mollinga P. <i>et al.</i> “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES:

1	Technical Advisory Committee, Background Papers No:1, 4 and 7, Stockholm, Sweden.2002.
2	IWRM Guidelines at River Basin Level (UNESCO, 2008).

COURSE OUTCOMES:

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

CO1:	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2:	Discuss on the different water uses; how it is impacted and ways to tackle the seimpacts.



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CO3:	Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO4:	Illustrate the recent trend in water management.
CO5:	Understand the implementation hitches and the institutional framework.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

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Department	BME	Programme Code & Name			Open to all Departments		
Semester							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UBMOE2401	BASICS OF MICROBIAL TECHNOLOGY		L	T	P	C	100
			3	0	0	3	
Course Objectives	The student should be made to: The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.						

Unit-I	BASICS OF MICROBES AND ITS TYPES	(9)
Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.		
Unit-II	MICROBIAL TECHNIQUES	(9)
Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.		
Unit-III	PATHOGENIC MICROBES	(9)
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.		
Unit-IV	BENEFICIAL MICROBES	(9)
Applications of microbes–Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.		
Unit-V	PRODUCTS FROM MICROBES	(9)
Fermented products–Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products– Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines		
Total No of Periods to be Taught		45 periods

TEXT BOOK:		
1	TalaronK,TalaronA,Casita,PelczarandReid.FoundationsinMicrobiology,W.C.Brown Publishers, 1993.	
2	PelczarMJ,ChanECSandKreinNR,Microbiology,TataMcGrawHillEdition,NewDelhi, India.	
3	PrescottL.M.,HarleyJ.P.,Kl3einDA,Microbiology,3rdEdition,Wm.C.BrownPublishers, 1996.	


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REFERENCES:

1	Berg, Jeremy M.etal.“Biochemsitry”,6thEdition,W.H.Freeman&Co., 2006.
2	Murray,R.K.,etal“Harper’sllustratedBiochemistry”,31stEdition,McGraw-Hill,2018.
3	Voet,D.andVoet,J.G.,“Biochemistry”,4thEdition,JohnWiley&SonsInc.,2010.

COURSE OUTCOMES:

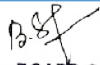
On completion of the course, the students will be able to

CO1:	Students will learn about various kinds of biomolecules and their physiological role.
CO2:	Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.
CO3:	Students will learn about various kinds of Infectious Disease – Awareness, Causative agent, Prevention and control
CO4:	Students will gain knowledge beneficial microbes
CO5:	Students will learn about various kinds of products from microorganisms

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	1		-	-
CO2	3	3	1	1	1	-	-	-	-	-	1		-	-
CO3	3	3	1	1	1	-	-	-	-	-	1		-	-
CO4	3	3	1	1	1	-	-	-	-	-	1		-	-
CO5	3	3	1	1	1	-	-	-	-	-	1		-	-
Avg.	3	3	1	1	1	-	-	-	-	-	1		-	-

1 – Slight, 2 – Moderate, 3 –Substantial, BT – Bloom’s Taxonomy


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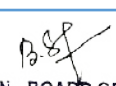


Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2402	RADIOLOGICAL EQUIPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	The student should be made to: • Understand generation of x-rays and its uses in imaging. • Learn different types of radio diagnostic techniques. • Know techniques used for visualizing different sections of the body. • Learn radiation therapy methodologies and the radiation safety.					

Unit-I	MEDICAL X-RAY EQUIPMENT	(9)
Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.		
Unit-II	COMPUTED TOMOGRAPHY	(9)
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.		
Unit-III	MAGNETIC RESONANCE IMAGING	(9)
Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, MRI.		
Unit-IV	NUCLEAR MEDICINE SYSTEM	(9)
Applications of microbes–Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.		
Unit-V	RADIATION THERAPY AND RADIATION SAFETY	(9)
Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments- Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelphia, 1988 (Units I, II, III & IV).
2	R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.

REFERENCES:

1	Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
2	B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C Barber, "Medical physics and biomedical Engineering", - CRC Press, 1999
3	Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4	P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine

COURSE OUTCOMES:

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

CO1:	Describe the working principle of X-ray machine and its applications.
CO2:	Illustrate the principle of Computed Tomography (CT).
CO3:	Interpret the techniques used for visualizing various sections of the body using Magnetic Resonance Imaging (MRI).
CO4:	Demonstrate the applications of radionuclide imaging / nuclear medicine imaging.
CO5:	Outline the methods of radiation safety and protection.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	-	-	-	-	-	1	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	1	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	1	-	-	-
CO4	3	3	1	1	-	-	-	-	-	-	1	-	-	-
CO5	3	3	1	1	1	-	-	-	-	-	1	-	-	-
Avg.	3	3	1	1	1	-	-	-	-	-	1	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2403	FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To provide knowledge on the fundamentals of cell biology. • To understand the signalling mechanisms. • To Understand basic principles of molecular biology at intracellular level to regulate growth, division and development					

Unit-I	INTRODUCTION TO CELL	(9)
Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organization, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria, mycoplasma and prions		
Unit-II	CELL ORGANELLES	(9)
Molecular organization, biogenesis and function Mitochondria, endoplasmic reticulum, Golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalization		
Unit-III	BIO-MEMBRANE TRANSPORT	(9)
Physiochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical organization of lipids and proteins. Solute transport across membrane's-fick's law, simple diffusion, passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport ATP ases, membrane transport in bacteria and animals. Transport mechanism- mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration		
Unit-IV	CELL CYCLE	(9)
Cell cycle- Cell division by mitosis and meiosis, Comparison of meiosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.		
Unit-V	CENTRAL DOGMA	(9)
Overview of Central dogma DNA replication: Meselson & Stahl experiment, bi-directional DNA replication, Okazaki fragments. Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation and termination of RNA synthesis Introduction to Genetic code- Steps in translation: Initiation, Elongation and termination of protein synthesis.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Cooper, G.M. and R.E. Hansman “The Cell: A Molecular Approach”, 8th Edition, Oxford University Press, 2018
2	Friefelder, David. “Molecular Biology.” Narosa Publications, 1999

REFERENCES:

1	Lodish H, Berk A, Matsudaira P, Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J. Molecular Cell Biology, 6th Edition, 2007
2	Becker, W.M. et al., “The World of the Cell”, 9 th Edition, Pearson Education, 2003.
3	Campbell, N.A., J.B. Reece and E.J. Simon “Essential Biology”, VIIrd Edition, Pearson International, 2007

COURSE OUTCOMES:

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

CO1:	Understanding of cell at structural and functional level.
CO2:	Understand the central dogma of life and its significance.
CO3:	Comprehend the basic mechanisms of cell division.
CO4:	Study on the Cell cycle
CO5:	Students will learn about Central dogma

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO4	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	1	-	-	-
Avg.	3	2	3	1	-	-	-	-	-	-	1	-	-	-

1 – Slight, 2 – Moderate, 3 –Substantial, BT – Bloom’s Taxonomy


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Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2404	HUMAN PHYSIOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	The student should be made to: The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.					

Unit-I	BASIC ELEMENTS OF HUMAN BODY	(9)
Cell: Structure and organelles - Functions of each component in the cell. Cell membrane –transport across membrane – origin of cell membrane potential – Action potential. Tissue: Types – Specialized tissues – functions.		
Unit-II	SKELETAL AND RESPIRATORY SYSTEM	(9)
Skeletal system: Bone types and functions – Joint - Types of Joint - Cartilage and functions. Respiratory System: Components of respiratory system – Respiratory Mechanism. Types of respiration - Oxygen and carbon dioxide transport and acid base regulation		
Unit-III	CIRCULATORY SYSTEM	(9)
Blood composition - functions of blood – functions of RBC. WBC types and their functions. Blood groups – importance of blood groups – identification of blood groups. Blood vessels- Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – ECG - Heart sound		
Unit-IV	URINARY AND SPECIAL SENSORY SYSTEM	(9)
Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation – Urinary reflex – Homeostasis and blood pressure regulation by urinary system. Special senses: Eye and Ear.		
Unit-V	NERVOUS SYSTEM	(9)
Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential in neuron. Brain – Divisions of brain lobes - Cortical localizations and functions - EEG. Spinal cord – Tracts of spinal cord - Reflex mechanism – Types of reflex. Autonomic nervous system and its functions.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Elaine.N. Marieb, “Essential of Human Anatomy and Physiology”, Eight Edition, Pearson Education, New Delhi ,2007.
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REFERENCES:

1	Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2009
2	William F.Ganong, “Review of Medical Physiology”, 22 nd Edition, Mc Graw Hill, New Delhi, 2005

COURSE OUTCOMES:

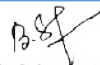
On completion of the course, the students will be able to

CO1:	Describe basic structural and functional elements of human body.
CO2:	Explain organs and structures involving in system formation and functions.
CO3:	Identify all systems in the human body.
CO4:	Study on the Urinary system and sensory system
CO5:	Students will learn about nervous system

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO4	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	1	-	-	-
Avg.	3	2	3	1	-	-	-	-	-	-	1	-	-	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy


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Department	BME	Programme Code & Name	Open to all Departments
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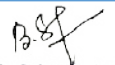
Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2405	LIFESTYLE DISEASES	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To study the cell types and differentiation. • To study basics about stem cells and its applications • To understand the methods and design involved in tissue engineering					

Unit-I	INTRODUCTION	(9)
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise		
Unit-II	CANCER	(9)
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment		
Unit-III	CARDIOVASCULAR DISEASES	(9)
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation		
Unit-IV	DIABETES AND OBESITY	(9)
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI		
Unit-V	RESPIRATORY DISEASES	(9)
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing		
Total No of Periods to be Taught		45 periods

TEXT BOOK:

1	R. Kumar & Meenal Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003
2	Gary Eggar et al, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017


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REFERENCES:

1	James M.R, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013
2	Akira Miyazaki et al, “New Frontiers in Lifestyle-Related Disease”, Springer, 2008

COURSE OUTCOMES:

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

CO1:	Explain the concept of lifestyle diseases, their causes, risk factors, and preventive measures.
CO2:	Describe different types of cancer, their causes, diagnosis methods, and treatment approaches.
CO3:	Analyze cardiovascular diseases, their risk factors, diagnostic techniques, treatment, and rehabilitation.
CO4:	Illustrate the types of diabetes mellitus, obesity, complications, and methods for weight control using BMI.
CO5:	Discuss respiratory diseases such as asthma and COPD, their causes, diagnosis, and prevention.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO4	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	1	-	-	-
Avg.	3	2	3	1	-	-	-	-	-	-	1	-	-	-

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Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2406	PATHOLOGY AND MICROBIOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Gain a knowledge on the structural and functional aspects of living organisms. • Know the etiology and remedy in treating the pathological diseases. • Empower the importance of public health.					

Unit-I	CELL DEGENERATION, REPAIR AND NEOPLASIA	(9)
Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours. Autopsy and biopsy.		
Unit-II	FLUID AND HEMODYNAMIC DERRANGEMENTS	(9)
Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas		
Unit-III	MICROSCOPES	(9)
Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining.		
Unit-IV	MICROBIAL CULTURES	(9)
Morphological features and structural organization of bacteria, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture.		
Unit-V	IMMUNOLOGY	(9)
Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Old RW, Primrose SB, “Principles of Gene Manipulation, An Introduction to Genetic Engineering”, Blackwell Science Publications, 1993.
2	Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed. (Blackwell Publishing).

REFERENCES:

1	Isil Aksan Kurnaz, “Techniques in Genetic Engineering”, CRC Press, 2015.
2	Oksana Ableitner, “Introduction to Molecular Biology: Working with DNA and RNA (essentials)”, Springer International, 2022.
3	Arun K. Shukla, “Proteomics in Biology”, Academic Press, 2017.o

COURSE OUTCOMES:

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

CO1:	Analyze structural and functional aspects of living organisms.
CO2:	Explain the function of microscope
CO3:	Discuss the importance of public health.
CO4:	Describe methods involved in treating the pathological diseases
CO5:	Study about the immunology and immune system

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO4	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	1	-	-	-
Avg.	3	2	3	1	-	-	-	-	-	-	1	-	-	-

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Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2407	MEDICAL ELECTRONICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	The students will be exposed to electrical and non-electrical physiological measurements and bioamplifiers					

Unit-I	BIO POTENTIAL ELECTRODES	(9)
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits		
Unit-II	ELECTRODE CONFIGURATIONS	(9)
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.		
Unit-III	BIO AMPLIFIER	(9)
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference		
Unit-IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	(9)
Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods. Blood flow measurement Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method,		
Unit-V	BIO-CHEMICAL MEASUREMENT	(9)
Biochemical sensors - pH, pO ₂ and pCO ₂ , Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)
2	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003. (Units II & IV)

COURSE OUTCOMES:

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

CO1:	Perform electrical and non-electrical physiological measurements
CO2:	Explain the function of bio amplifiers.
CO3:	Students will learnt about bio amplifier AC and DC
CO4:	Measurement of non-electrical parameters blood pressure
CO5:	Students will learnt about biochemical measurements

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POS1	PSO2	PSO3
CO1	3	2	1	-	-	1	1	-	-	-	-	-	-	-
CO2	3	2	1	-	-	1	1	-	-	-	-	-	-	-
CO3	3	2	1	-	-	1	1	-	-	-	-	-	-	-
CO4	3	2	1	-	-	1	1	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	1	-	-	-	-	-	-	-
Avg.	3	2	1	-	-	1	1	-	-	-	-	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	Open to all Departments
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UBMOE2408	ASSIST DEVICES	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Study various mechanical techniques that will help failing heart. • Learn the functioning of the unit which does the clearance of urea from the blood • Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss. • Know the various orthotic devices and prosthetic devices to overcome orthopedic problems. • Understand electrical stimulation techniques used in clinical applications.					

Unit-I	CARDIAC ASSIST DEVICES	(9)
Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.		
Unit-II	HEMODIALYSERS	(9)
Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.		
Unit-III	HEARING AIDS	(9)
Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.		
Unit-IV	PROSTHETIC AND ORTHODIC DEVICES	(9)
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, and sensory assist devices.		
Unit-V	RECENT TRENDS	(9)
Transcutaneous electrical nerve stimulator, bio-feedback.		
Total No of Periods to be Taught	45 periods	


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TEXT BOOK:

1	Levine S.N. (ed), "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968 (Unit I, IV, V).
2	Kolff W.J, "Artificial Organs", John Wiley and sons, New York, 1976. (Unit II).

REFERENCES:

1	D.S. Sunder, "Rehabilitation Medicine", 3 rd Edition, Jaypee Medical Publication, 2010.
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COURSE OUTCOMES:

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

CO1:	Explain the functioning and usage of electromechanical units which will restore normal functional ability of particular organ that is defective temporarily or permanently
CO2:	Explain the functioning and usage of hemodialysers and its functional parameters
CO3:	To study about the Common tests – audiograms, air conduction, bone conduction
CO4:	Knowledge on prosthetic and orthodic devices
CO5:	To know about the knowledge on recent trends

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO2	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO3	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO4	3	2	1	-	-	1	-	1	-	1	1	-	-	-
CO5	3	2	1	-	-	1	-	1	-	1	1	-	-	-
Avg.	3	2	1	-	-	1	-	1	-	1	1	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2401	ELECTRICAL SAFETY	3	0	0	3	100
Course Objectives	- To provide an overview of electrical safety, shocks and their prevention. - To Understand the electrical safety in residential, commercial and agricultural installations - To familiarise with electrical safety during installation, testing and commissioning, operation and maintenance - To provide an overview of electrical hazardous areas					

Unit-I	INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION	(9)
Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shop.		
Unit-II	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS	(9)
Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations – Agricultural pump installation Do's and Don'ts for safety in the use of domestic electrical appliances.		
Unit-III	ELECTRICAL SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE	(9)
Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety - personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety..		
Unit-IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS	(9)
Hazardous zones –class 0,1 and 2 spark, flashovers and corona discharge and functional requirements –Specifications of electrical plants, equipment's for hazardous locations –Classification of equipment enclosure for various hazardous gases and vapours –classification of equipment/enclosure for hazardous locations		
Unit-V	FIRE EXTINGUISHERS	(9)
Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system;CO2 and Halogen gas schemes; foam schemes.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988
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REFERENCES:

1	Cooper.W.F, “Electrical safety Engineering”, Newnes-Butterworth Company, 1978.
2	John Codick, “Electrical safety hand book”, McGraw Hill Inc., New Delhi, 2000.
3	Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
4	Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004.

COURSE OUTCOMES:

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

CO1:	Understand the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas and use of fire extinguishers.
CO2:	Apply various fire extinguishers and the Electrical Safety to prevent the Electric Shocks in residential, commercial, agriculture and hazardous areas;
CO3:	Apply the Electrical Safety to prevent the Electric Shocks during installation, testing, commissioning, Operation and Maintenance
CO4:	Analyse the Electrical Safety, Electric Shocks and Their Prevention.
CO5:	Examine the Electrical Safety in hazardous areas and the use of various fire extinguishers.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

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Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2402	INTRODUCTION TO ELECTRICAL MACHINES	3	0	0	3	100
Course Objectives	- To introduce the principles of operations of DC machines as motor and generator - To introduce the principles of operations of Transformers - To introduce the principles of operations of Induction machines. - To introduce the principles of operations of Synchronous machines. - To introduce other special machines					

Unit-I	D.C. MACHINES	(9)
D.C. Machines – Principle of operation and construction of motor and generator – torque and EMF equation — Characteristics of Motor and Generator – Starting, Speed control and braking of D.C. Motor		
Unit-II	TRANSFORMERS	(9)
Principle , Construction and Types of Transformer - EMF equation - Equivalent circuits - Phasor diagrams - Regulation and efficiency of a transformer-three phase transformer Connection.		
Unit-III	SYNCHRONOUS MACHINES	(9)
Principle of Operation, type - EMF Equation and Phasor diagrams - Synchronous motor-Rotating Magnetic field Starting Methods , Torque V-Curves, inverted – V curves		
Unit-IV	THREE PHASE INDUCTION MOTORS	(9)
Constructional details – Types of rotors — Principle of operation – Slip - Equivalent circuit – Torque-Slip characteristics - Starting, Speed control and induction motor.		
Unit-V	SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	(9)
Types of single phase induction motors – Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor - Permanent magnet synchronous motor – Switched reluctance motor – Brushless D.C motor.		
Total No of Periods to be Taught		45

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1	B.S.Guru and H.R.Hiziroglu, “Electric Machinery and Transformer”, Oxford university Press 2007
2	M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009
3	Deshpande M. V., “Electrical Machines” PHI Learning Pvt. Ltd., New Delhi, 2011.

REFERENCES:

1	Del Toro, V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi, 1995.
2	Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., “Electric Machinery”, McGraw- Hill, Singapore, 2000.
3	Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata McGraw Hill. Publishing Company Ltd, 2010
4	M.S. Sarma and M.K.Pathak, “Electric Machines”, Cengage Learning, 2012. 5. C.A.Gross, “Electric Machines”, CRC Press 2010

COURSE OUTCOMES:

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

CO1:	Explain the construction and working principle of DC machines.
CO2:	Describe the working principle of auto transformer, three phase transformer with different types of connections.
CO3:	Ability to understand the construction and working principle of Synchronous Machines
CO4:	Ability to understand the construction and working principle of Three Phase Induction Motor and knowledge about the starting and speed control of induction motors.
CO5:	To gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom’s Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2403	ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION	3	0	0	3	100
Course Objectives	- To study the generation, conservation of electrical power and energy efficient equipments. - To understand the principle, design Of Illumination Systems and energy Efficiency lamps. - To study the methods of industrial heating and welding. - To understand the electric traction systems and their performance.					

Unit-I	GENERATION OF ELECTRIC POWER CONVENTIONAL SOURCES	(9)
Hydro station, Thermal Power Plant, Nuclear Power Plant and Gas Turbine Plant. Non-Conventional Sources (Qualitative): Ocean Energy, Tidal Energy, wind Energy, and Solar Energy.		
Unit-II	ILLUMINATION	(9)
Importance of lighting – properties of good lighting scheme – laws of illumination – photometry types of lamps–lighting calculations–basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting – LED lighting and energy efficient lamps.		
Unit-III	TRACTION	(9)
Merits of electric traction–requirements of electric traction system–supply systems - mechanics of train movement – traction motors and control – braking – recent trends in electric traction		
Unit-IV	HEATING AND WELDING	(9)
Role of electric heating for industrial applications–resistance heating–induction heating– dielectric heating - electric arc furnaces. Brief introduction to electric welding–welding generator, welding transformer and the characteristics		
Unit-V	DOMESTIC UTILIZATION OF ELECTRICAL ENERGY	(9)
Domestic utilization of electrical energy – House wiring. Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing.		
Total No of Periods to be Taught	45	

TEXT BOOK:	
1	Wadhwa, C.L. “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt. Ltd, 2003.

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2	Dr.Uppal S.L.and Prof.S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3	Energy Efficiency in Electric Utilities, BEE Guide Book,2010

REFERENCES:

1	Partab.H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
2	OpenshawTaylor.E, “UtilizationofElectricalEnergyinSIUnits”,OrientLongmanPvt.Ltd, 2003.
3	Gupta.J.B, “UtilizationofElectricPowerandElectricTraction”,S.K.KatariaandSons, 2002.
4	Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

COURSE OUTCOMES:

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

CO1:	To understand them a in aspects of generation, utilization and conservation.
CO2:	To understand them a in aspects of illuminations
CO3:	To realize the appropriate type of electric supply system as well as to evaluate the performance of a traction unit.
CO4:	To understand the main aspects of Traction and method of heating
CO5:	To evaluate domestic wiring connection and debug any faults occurred

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom’s Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week	Credit	Maximum Marks
UEEOE2404		L T P	C	100

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	POWER ELECTRONICS AND DRIVES	3	0	0	3	
Course Objectives	- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics - Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers - Detailed knowledge on Classifications, structure, operating principle of dc choppers. - Introduction to different types of Inverters , their principle of operation and waveform control - Overview on dc and ac drives and their control using power electronic circuits.					
Unit-I	POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS	(9)				
Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits.						
Unit-II	CONTROLLED RECTIFIERS AND AC CONTROLLERS	(9)				
Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cyclo converters, Matrix converters						
Unit-III	DC TO DC CONVERTERS	(9)				
Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators						
Unit-IV	INVERTERS	(9)				
Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters						
Unit-V	DRIVES AND CONTROL	(9)				
Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only)– Introduction to vector control of AC drives..						
Total No of Periods to be Taught		45				

TEXT BOOK:

1	Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 3rd Edition, 2004.
2	Mohan, Udeland and Robbins., “Power Electronics”, John Wiley and Sons, New York, 1995.

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REFERENCES:

1	Singh, M.D., and Khanchandani, K.B., “Power Electronics”, 2nd Edition., Tata McGraw-Hill, 2011.
2	2. Bose, B.K., “Modern Power Electronics and AC Drives”, Pearson Education, 2002.
3	Bimbira, P.S., “Power Electronics”, Khanna Publishers, 2006.
4	Moorthi, V.R., “Power Electronics - Devices, Circuits and Industrial Applications”, Oxford University Press, 2005
5	NPTEL Lecture Series on “Power Electronics” by Dr.B.G.Fernandes, IIT Bombay.

COURSE OUTCOMES:

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

CO1:	Ability to explain various devices and their structure, operating characteristics in the field of electronics.
CO2:	Ability to classify, analyze and design, Control rectifiers and AC controllers
CO3:	Ability to classify, analyze and design, DC to DC convertors,
CO4:	Ability to classify, analyze and design, inverters
CO5:	Will have ability to apply power electronic circuits for the control of popular applications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2405	ELECTRICAL ESTIMATION AND COSTING	3	0	0	3	100

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Course Objectives	- Emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost availability. - Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design. - These techniques should help the students to successfully estimate costing of the products/projects that are part of our everyday usage. - A basic knowledge on methods and types of estimation and its merits and demerits. - To prepare the schedule of materials with specifications and estimates for different types of electrical installations.
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Unit-I	DESIGN CONSIDERATIONS OF ELECTRICAL INSTALLATIONS	(9)
Electric Supply System, Three phase four wire distribution system, General requirements of Electrical Installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections, Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution Board		
Unit-II	ELECTRICAL INSTALLATION OF BUILDINGS AND SMALL INDUSTRIES	(9)
Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.		
Unit-III	OVERHEAD AND UNDERGROUND TRANSMISSION AND DISTRIBUTION LINES	(9)
Introduction, Supports for Transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.		
Unit-IV	SUBSTATIONS:	(9)
Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substation, Floor mounted type.		
Unit-V	DESIGN OF ILLUMINATION SCHEMES:	(9)
Introduction, Terminology in Illumination, laws of illumination, various types of light sources, Practical lighting schemes		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Electrical Design Estimating and Costing, K.B. Raina, S.K. Bhattacharya, New Age International Publisher
2	Design of Electrical Installations, Dr. V.K. Jain, Dr. Amitabh Bajaj, University Science Press.
3	Electricity pricing Engineering Principles and Methodologies, Lawrence J. Vogt, P.E., CRC Press.

REFERENCES:	
1	Guide for Electrical Layout in residential buildings, Indian Standard Institution, IS:4648-1968

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2	Electrical Installation buildings Indian Standard Institution, IS:2032
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COURSE OUTCOMES:

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

CO1:	The estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost viability.
CO2:	Exposure to design and estimation of wiring,
CO3:	Design of overhead and underground distribution lines, substations and illuminations design.
CO4:	Understand types of substations and their ratings
CO5:	To design illumination systems.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2406	BASICS OF ELECTRICAL MEASUREMENTS AND INSTRUMENTATION	3	0	0	3	100

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Course Objectives	- To educate the fundamental concepts and characteristics of measurement and errors - To impart the knowledge on the functional aspects of measuring instruments - To infer the importance of various bridge circuits used with measuring instruments. - To educate the fundamental working of sensors and transducers and their applications - To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.
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Unit-I	CONCEPTS OF MEASUREMENTS	(9)
Instruments: classification, working and applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.		
Unit-II	MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS	(9)
Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).		
Unit-III	AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS	(9)
Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.		
Unit-IV	TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS	(9)
Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.		
Unit-V	OTHER ENERGY SOURCES	(9)
A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	A.K. Sawhney, PuneetSawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, DhanpatRai and Co, New Delhi, Edition 2011.
2	H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010
3	Scott Grinnell, “Renewable Energy & Sustainable Design”, CENGAGE Learning, USA, 2016.

REFERENCES:	
1	M.M.S. Anand, ‘Electronics Instruments and Instrumentation Technology’, Prentice Hall India, New Delhi, 2009
2	J.J. Carr, ‘Elements of Electronic Instrumentation and Measurement’, Pearson Education India, New Delhi, 2011

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3	W.Bolton, Programmable Logic Controllers, 6th Edition, Elsevier, 2015.
4	R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3rd Edition 2014.
5	E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.
6	R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016

COURSE OUTCOMES:

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

CO1:	Ability to understand the fundamental art of measurement in engineering.
CO2:	Ability to understand the structural elements of various instruments.
CO3:	Ability to understand the importance of bridge circuits.
CO4:	Ability to understand about various transducers and their characteristics by experiments.
CO5:	Ability to understand the concept of digital instrumentation and virtual instrumentation by log/antilog amplifier, analog multiplier /divider, active filters, comparators, waveform generators, A/D and D/A converters

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	-	3	2	-	2	-	-	3	3	3	3
CO2	3	2	3	2	-	-	-	-	-	3	3	3	3	3
CO3	3	2	3	-	3	2	-	-	-	-	3	3	3	3
CO4	3	2	3	-	-	-	-	2	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-	-	-	3	3	3	3	3
Avg.	3	2	3	2	3	2	-	2	-	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2407	INTRODUCTION TO CONTROL ENGINEERING	3	0	0	3	100

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Course Objectives	To introduce the control system components and transfer function model with their graphical representation To understand the analysis of system in time domain along with steady state error. To introduce frequency response analysis of systems To accord basic knowledge in design of compensators To introduce the state space models.
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Unit-I	MATHEMATICAL MODELLING	(9)
Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies		
Unit-II	FEEDBACK CONTROL SYSTEMS	(9)
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios		
Unit-III	STABILITY ANALYSIS	(9)
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit		
Unit-IV	STATE SPACE TECHNIQUE	(9)
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction frequency response.		
Unit-V	OTHER ENERGY SOURCES	(9)
State vectors–state space models-Digital Controllers–design aspects		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers,2017
2	Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014

REFERENCES:	
1	Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2	Richard C. Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009

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3	John J.D., Azzo Constantine, H. and HouppisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4	RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5	M. Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6	NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

COURSE OUTCOMES:

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

CO1:	To represent and develop systems in different forms using the knowledge gained
CO2:	To analyses the system in time and frequency domain
CO3:	Ability to Derive Transfer function Model of Electrical and Mechanical Systems.
CO4:	Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph
CO5:	To analyses the stability of physical systems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	2	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	2.8	3	3	2.8	2	2	1	-	-	-	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom’s Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2408	FUNDAMENTALS OF ELECTRICAL DRIVES AND CONTROL	3	0	0	3	100

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Course Objectives	- To study the conventional and solid-state drives - To study the different methods of starting D.C motors and induction motors. - To understand the basic concepts of different types of electrical machines and their performance
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Unit-I	INTRODUCTION	(9)
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors		
Unit-II	DRIVE MOTOR CHARACTERISTICS	(9)
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.		
Unit-III	STARTING METHODS	(9)
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors		
Unit-IV	CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES	(9)
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.		
Unit-V	CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	(9)
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications..		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	VedamSubrahmaniam, “Electric Drives (Concepts and Applications”, Tata McGraw-Hill, 2001
2	Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 1998

REFERENCES:	
1	Pillai.S.K “A First Course on Electric Drives”, Wiley Eastern Limited, 1998

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2	Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 1998
3	Partab. H., “Art and Science and Utilisation of Electrical Energy”, DhanpatRai and Sons, 1994.

COURSE OUTCOMES:

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

CO1:	Derive the heating and cooling curve and study the various classes of duty and Selection of power rating
CO2:	Understand the working principle of DC & AC motors and their characteristics and its braking methods
CO3:	Understand the Starting methods of DC & AC motors
CO4:	Understand the Concepts of speed control in DC motors
CO5:	Understand the Concepts of speed control in AC motors

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	-	3	2	2	-	-	-	3	3	3
CO2	3	2	3	2	-	-	-	-	3	-	3	3	3
CO3	3	2	3	-	3	2	-	-	-	-	3	3	3
CO4	3	2	3	-	-	-	2	-	-	-	-	3	3
CO5	3	2	3	2	3	-	-	-	3	-	3	3	3
Avg.	3	2	3	2	3	2	2	-	3	-	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UEEOE2409	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	100

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Course Objectives	• Understand and analyses the energy data of industries • Carryout energy accounting and balancing • Conduct energy audit and suggest methodologies for energy savings. • Utilize the available resources in optimal ways
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Unit-I	INTRODUCTION	(9)
Energy-Power-Past & Present scenario of World; National Energy consumption Data Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.		
Unit-II	ELECTRICAL SYSTEMS	(9)
Power system structure, Electrical tariff and types- Illumination–Lux, Lumens, law of illumination -Types of lighting, LED Lighting and. Energy Efficient Lighting.		
Unit-III	THERMAL SYSTEMS	(9)
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters–Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators& Refractories		
Unit-IV	ENERGYCONSERVATIONINMAJORUTILITIES	(9)
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers –D.G. sets.		
Unit-V	ECONOMICS	(9)
Energy Economics–Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing–ESCO concept		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com .a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.Power, Government of India, 2004

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1	Witte.L.C.,P.S.Schmidt,D.R.Brown,“IndustrialEnergyManagementandUtilisation” Hemisphere Publ, Washington, 1988.
2	Callaghn,P.W.“Design and Management for Energy Conservation ”,Pergamon Press, Oxford, 1981.
3	Dryden.I.G.C.,“TheEfficientUseofEnergy”Butterworths,London,1982
4	Turner.W.C.,“EnergyManagementHandbook”,Wiley,NewYork,1982.
5	Murphy. W.R.andG.McKAY,“EnergyManagement”,Butterworths,London1987

COURSE OUTCOMES:

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

CO1:	Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2:	Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3:	Skills on combustion thermodynamics and kinetics.
CO4:	Apply calculation and design tube still heaters.
CO5:	Studied different heat treatment furnace.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	2	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2	2	2	1	-	-	-	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy														

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week	Credit	Maximum Marks
UEEOE2410		L T P	C	100

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	AUTOMOTIVE AND ENGINEERING	ELECTRICAL ELECTRONICS	3	0	0	3	
Course Objectives	The objective of this course is to prepare the students to become familiar with the basic concepts and applications of different sensor and actuators used for electronic control, different communication protocols and networking in vehicles						

Unit-I	INTRODUCTION AND AUTOMOTIVE BATTERIES	(9)
Introduction Overview of vehicle electrical systems Electrical circuits Electrical power supply in conventional vehicle Dimensioning of wires Circuit diagrams and symbols. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing Maintenance free batteries – Battery		
Unit-II	STARTING AND CHARGING SYSTEM	(9)
Starter Motors – Development and Starting requirements in the IC engines starter motor design – Starter motor design variations – starter motor control and power circuits		
Unit-III	IGNITION, LIGHTING AND AUXILLARY SYSTEM	(9)
Ignitions System Ignition fundamentals Electronic ignition Programmed ignition Distributor less ignition Direct ignition Spark plugs. Automotive lighting Technology –Technical demands Development of lighting technology Light sources – physical principles – Front and rear lighting system Interior lighting system – Special purpose lamps – Adaptive Lighting system Instrument clusters Wiper and Washer systems electric horns		
Unit-IV	AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS	(9)
Automotive Electronics overview and Basic principles of semiconductor technology Electronic Components semiconductor components. Automotive Sensors – Basic Sensors : Position, speed, Force/Torque, Flow meters, Automotive Actuators Electromechanical actuators Fluid mechanical actuators		
Unit-V	VEHICLE NETWORKING	(9)
Data transfer between automotive Electronics systems Basic principles of networking- Network topology- Network organization OSI reference model Control mechanisms communication protocols in embedded systems Vehicle Communication Protocols		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5

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1	Barry Hole beak, “Automotive Electrical and Electronics” , Delmar Publishers, Clifton Park,USA,2010
2	James D Halderman, “Automotive Electrical and Electronics”, Prentice Hall, USA, 2013
3	Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International
4	William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

COURSE OUTCOMES:

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

CO1:	Define the glossary related to vehicle electrical and electronic system
CO2:	Explain the need for starter batteries, starter motor and alternator in the vehicle.
CO3:	Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
CO4:	List common types of sensor and actuators used in vehicles
CO5:	Understand networking in vehicles.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO3	2	3	3	3	2	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	2	1	-	-	-	3	3	3	3
Avg.	2.8	3	3	2.8	2	2	1	-	-	-	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom’s Taxonomy														

Department	EEE	Programme Code & Name	Open to All Departments
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Course Code	Course Name	Hours/Week	Credit	Maximum Marks
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UEEOE2411	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To familiarize students with the fundamental concepts of embedded systems, including their architecture, hardware, and software components, and to provide experience in designing and implementing simple embedded systems					

Unit-I	BASICS OF COMPUTER ARCHITECTURE AND THE BINARY NUMBER SYSTEM	(9)
Basics of computer architecture, computer languages, RISC and CISC architectures, number systems, number format conversions, computer arithmetic, units of memory capacity.		
Unit-II	INTRODUCTION TO EMBEDDED SYSTEMS	(9)
Application domain of embedded systems, desirable features and general characteristics of embedded systems, model of an embedded system, microprocessor Vs microcontroller, example of a simple embedded system, merit for an embedded system, classification of MCUs: 4/8/16/32 bits, history of embedded systems		
Unit-III	EMBEDDED SYSTEMS-THE HARDWARE POINT OF VIEW	(9)
Microcontroller unit(MCU), a popular 8-bit MCU, memory for embedded systems, low power design, pull up and pull down resistors		
Unit-IV	SENSORS, ADCs AND ACTUATORS	(9)
Sensors: Temperature Sensor, Light Sensor, Proximity/range Sensor; Analog to digital converters: ADC Interfacing; Actuators Displays, Motors, Opto couplers / Opto isolators, relays.		
Unit-V	EXAMPLES OF EMBEDDED SYSTEMS	(9)
Mobile phone, automotive electronics, radio frequency identification (RFID), wireless sensor networks(WISENET), robotics, biomedical applications, brain machine interface		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Lyla B Das, Embedded systems: An Integrated Approach, 1st Ed., Pearson, 2013

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1	Shibu, K.V., Introduction to Embedded Systems, 1st Ed., TMH, 2009
2	KantaRao B, Embedded Systems, 1st Ed., PHI
3	Frank Vahid& Tony Givargis, Embedded System Design, 2nd Edition, John Wiley,

COURSE OUTCOMES:

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

CO1:	learn about the general principles of computer architecture
CO2:	learn about the working of a simple embedded system and embedded system applications
CO3:	learn the hardware aspects of embedded systems
CO4:	Understand the sensors, ADCs and actuators used in embedded systems
CO5:	Understand the real world examples of embedded systems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	-	3	2	2	-	-	-	3	3	3
CO2	3	2	3	2	-	-	-	-	3	-	3	3	3
CO3	3	2	3	-	3	2	-	-	-	-	3	3	3
CO4	3	2	3	-	-	-	2	-	-	-	-	3	3
CO5	3	2	3	2	3	-	-	-	3	-	3	3	3
Avg.	3	2	3	2	3	2	2	-	3	-	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2401	FINANCIAL MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To acquire the knowledge of the decision areas in finance. • To learn the various sources of Finance • To describe about capital budgeting and cost of capital. • To discuss on how to construct a robust capital structure and dividend policy • To develop an understanding of tools on Working Capital Management.					

Unit-I	INTRODUCTION TO FINANCIAL MANGEMENT	(9)
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.		
Unit-II	SOURCES OF FINANCE	(9)
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc.		
Unit-III	INVESTMENT DECISIONS	(9)
Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting - Payback -ARR – NPV – IRR –Profitability Index.Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.		
Unit-IV	FINANCING AND DIVIDEND DECISION	(9)
Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure . Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy.		
Unit-V	WORKING CAPITAL DECISION	(9)
Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill.
2	M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd.

REFERENCES:

1	James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,
2	Prasanna Chandra, Financial Management.
3	Srivatsava, Mishra, Financial Management, Oxford University Press, 2011.

COURSE OUTCOMES:

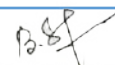
On completion of the course, the students will be able to

CO1:	Understand the fundamental concepts and objectives of financial management.
CO2:	Analyze various sources of finance and their suitability for business needs.
CO3:	Apply capital budgeting techniques and calculate cost of capital for investment decisions.
CO4:	Evaluate financing and dividend decisions to design an optimal capital structure.
CO5:	Manage working capital and related components effectively.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	1	-	-	-	3	2	-
CO2	3	3	2	2	2	-	-	1	-	-	-	3	3	-
CO3	3	3	3	3	3	-	-	1	-	-	-	3	3	-
CO4	3	3	3	2	2	-	-	2	2	-	-	3	3	-
CO5	3	3	3	2	3	-	-	2	-	-	-	3	3	-
Avg.	3	3	2.6	2.3	2	-	-	2.2	1	-	-	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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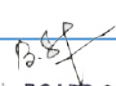


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2402	FUNDAMENTALS OF INVESTMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Describe the investment environment in which investment decisions are taken. - Explain how to Value bonds and equities - Explain the various approaches to value securities - Describe how to create efficient portfolios through diversification - Discuss the mechanism of investor protection in India.					

Unit-I	THE INVESTMENT ENVIRONMENT	(9)
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.		
Unit-II	FIXED INCOME SECURITIES	(9)
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.		
Unit-III	APPROACHES TO EQUITY ANALYSIS	(9)
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.		
Unit-IV	PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES	(9)
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.		
Unit-V	INVESTOR PROTECTION	(9)
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
2	Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.
3	Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
4	ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition (SIE), 2019.

COURSE OUTCOMES:

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

CO1:	Understand the investment environment, types of investment avenues, and the functioning of the Indian securities market.
CO2:	Analyze fixed income securities by evaluating bond features, pricing, yields, and various types of bond-related risks.
CO3:	Apply fundamental and technical analysis, and evaluate equity securities using valuation models like dividend and P/E models.
CO4:	Assess portfolio risk and return, understand mutual funds, and gain foundational knowledge of financial derivatives.
CO5:	Understand the role of regulatory bodies like SEBI in investor protection and analyze the mechanisms for grievance redressal.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	1	-	-	-	3	2	-
CO2	3	3	3	3	3	-	-	1	-	-	-	3	3	-
CO3	3	3	3	2	2	-	-	2	1	-	-	3	3	-
CO4	3	3	3	3	3	-	-	2	1	-	-	3	3	-
CO5	2	2	2	3	2	3	2	2	2	2	2	2	3	-
Avg.	3	3	3	3	2	-	-	2	1	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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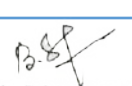


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2403	BANKING, FINANCIAL SERVICES AND INSURANCE	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the Banking system in India. - Grasp how banks raise their sources and how they deploy it - Understand the development in banking technology - Understand the financial services in India - Understand the insurance Industry in India					

Unit-I	INTRODUCTION TO INDIAN BANKING SYSTEM	(9)
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.		
Unit-II	MANAGING BANK FUNDS/ PRODUCTS	(9)
Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.		
Unit-III	DEVELOPMENT IN BANKING TECHNOLOGY	(9)
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money – forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.		
Unit-IV	FINANCIAL SERVICES	(9)
Introduction – Need for Financial Services – Financial Services Market in India – NBFC — Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking.		
Unit-V	INSURANCE	(9)
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2	Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
3	Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017 .

COURSE OUTCOMES:

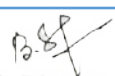
On completion of the course, the students will be able to

CO1:	Understand the structure, functions, and key regulations of the Indian banking system, including types of banking and accounts.
CO2:	Analyze bank fund management, various financial products, negotiable instruments, and current issues like NPAs and bank M&As.
CO3:	Examine advancements in banking technology, electronic payment systems, and cybersecurity in the context of RBI regulations.
CO4:	Evaluate various financial services in India such as NBFCs, leasing, mutual funds, venture capital, and merchant banking.
CO5:	Understand the concept and evolution of insurance in India, including regulatory frameworks and policy lifecycle management.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	2	-	-	-	3	2	-
CO2	3	3	3	2	3	2	-	2	-	-	-	3	3	-
CO3	2	2	3	3	3	2	2	2	2	-	-	2	3	-
CO4	3	3	3	2	2	-	-	1	1	-	-	3	3	-
CO5	2	2	2	3	2	3	2	1	1	2	2	2	2	-
Avg.	2	3	3	3	1	2.5	2	2	2	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2404	INTRODUCTION TO BLOCK CHAIN AND ITS APPLICATIONS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce the fundamental concepts of block chain technology. • To provide a comprehensive understanding of cryptocurrencies • To explain the Ethereum ecosystem. • To familiarize students with Web3 technologies and enterprise block chain protocols. • To explore emerging trends, platforms, and tools in block chain.					

Unit-I	INTRODUCTION TO BLOCKCHAIN	(9)
Block chain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.		
Unit-II	INTRODUCTION TO CRYPTOCURRENCY	(9)
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain.		
Unit-III	ETHEREUM	(9)
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network.		
Unit-IV	WEB3 AND HYPERLEDGE	(9)
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.		
Unit-V	EMERGING TRENDS	(9)
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018.
2	Peter Borovykh ,Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018.
3	ArshdeepBahga, Vijay Madiseti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

COURSE OUTCOMES:

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

CO1:	Understand the foundational principles, architecture, and decentralization features of blockchain systems.
CO2:	Analyze cryptocurrencies such as Bitcoin and altcoins, their operations, smart contracts, and deployment mechanisms.
CO3:	Apply knowledge of Ethereum architecture, token systems, and virtual machines in blockchain development.
CO4:	Evaluate Web3 and enterprise blockchain solutions like Hyperledger and Corda for decentralized application development.
CO5:	Explore emerging platforms, challenges, and trends in blockchain technology, including scalability, privacy, and tools.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	2	-	-	-	3	2	-
CO2	3	3	3	3	3	-	-	2	1	-	-	3	3	-
CO3	3	3	3	3	3	-	-	2	2	-	-	3	3	-
CO4	2	3	3	3	3	2	2	2	2	-	-	3	3	-
CO5	2	2	2	3	2	3	2	1	2	2	2	2	3	-
Avg.	3	3	3	3	3	2	2	2	2	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2405	FINTECH PERSONAL FINANCE AND PAYMENTS	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To introduce the concept and applications of cryptocurrencies and digital payment systems. •To explore the evolution of digital finance and alternative finance models. •To examine the emergence of InsurTech. •To understand Peer-to-Peer (P2P) lending and crowdfunding ecosystems. •To analyze the regulatory framework and challenges in FinTech and RegTech.					

Unit-I	CURRENCY EXCHANGE AND PAYMENT	(9)
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues.		
Unit-II	DIGITAL FINANCE AND ALTERNATIVE FINANCE	(9)
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering.		
Unit-III	INSURETECH	(9)
InsurTech Introduction , Business model disruption AI/ML in Insur Tech ● IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services.		
Unit-IV	PEER TO PEER LENDING	(9)
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of CrowdfundingCrowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations.		
Unit-V	REGULATORY ISSUES	(9)
FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform, 2016.
2	Models AuTanda, FintechBigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019.
3	Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016.
4	Jacob William, FinTech: The Beginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016.
5	IIBF, Digital Banking, Taxmann Publication, 2016.

COURSE OUTCOMES:

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

CO1:	Understand the fundamentals of cryptocurrencies, digital wallets, payment systems (e.g., UPI, RTGS), and associated legal and ethical issues.
CO2:	Analyze digital finance innovations and alternative financial models, including crowdfunding, ICOs, and equity-based platforms.
CO3:	Examine the role of InsurTech and how AI, ML, and IoT are transforming risk modeling, fraud detection, and insurance operations.
CO4:	Understand peer-to-peer lending and crowdfunding technologies, and evaluate their applications for SMEs and MSMEs.
CO5:	Analyze FinTech and RegTech regulatory environments globally and domestically, including AI-driven compliance and fraud detection.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	2	2	-	-	3	2	-
CO2	3	3	3	2	2	-	-	2	1	-	-	3	3	-
CO3	3	3	3	3	3	2	2	2	2	-	-	3	3	-
CO4	3	2	3	2	2	1	2	1	2	-	-	2	3	-
CO5	2	2	2	3	2	3	2	2	2	2	2	2	3	-
Avg.	3	3	3	3	3	2	2	2	2	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

10-8/1
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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2406	INTRODUCTION TO FINTECH	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To learn about history, importance and evolution of Fintech. • To acquire the knowledge of Fintech in payment industry. • To acquire the knowledge of Fintech in insurance industry. • To learn the Fintech developments around the world. • To know about the future of Fintech.					

Unit-I	INTRODUCTION	(9)
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.		
Unit-II	PAYMENT INDUSTRY	(9)
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, on boarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.		
Unit-III	INSURANCE INDUSTRY	(9)
FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.		
Unit-IV	PEER TO PEER LENDING	(9)
FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.		
Unit-V	FUTURE OF FINTECH	(9)
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2	Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016.
3	Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016.
4	Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018.
5	Sanjay Phadke, FintechFuture : The Digital DNA of Finance Paperback .Sage Publications, 2020.

COURSE OUTCOMES:

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

CO1:	Understand the evolution, scope, architecture, and economic significance of FinTech across various industries.
CO2:	Analyze FinTech applications in payments and lending, including wallet systems, KYC, P2P lending, and crowdfunding.
CO3:	Evaluate FinTech innovations in insurance and wealth management, including digital advice, P2P insurance, and claim automation.
CO4:	Compare global FinTech developments, regulatory policies, and collaborations between traditional institutions and FinTech firms.
CO5:	Explore the future of FinTech with emerging technologies, ethics, partnerships, and innovations in banking and finance.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	2	2	2	-	-	-	2	-	-	-	3	2
CO2	3	3	3	3	3	-	1	-	2	1	-	-	3	3
CO3	3	3	3	3	3	2	2	1	2	2	-	-	3	3
CO4	3	2	2	3	2	3	2	2	1	2	1	-	2	3
CO5	2	3	2	3	3	3	3	2	2	2	2	2	2	3
Avg.	3	3	3	3	3	2	2	2	2	2	2	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2407	FOUNDATIONS OF ENTREPRENEURSHIP	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To develop and strengthen the entrepreneurial quality and motivation of learners. • To impart the entrepreneurial skills and traits essential to become successful entrepreneurs. • To apply the principles and theories of entrepreneurship and management in Technology oriented businessess. • To empower the learners to run a Technology driven business efficiently and effectivelyTo know about the future of Fintech.					

Unit-I	INTRODUCTION TO ENTREPRENEURSHIP	(9)
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.		
Unit-II	BUSINESS OWNERSHIP & ENVIRONMENT	(9)
Types of Business Ownership – BuinessEnvrionemental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Reosurces Mobilisation-Basics of Managing Finance- Eentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.		
Unit-III	FUNDAMENTALS OF TECHNOPRENEURSHIP.	(9)
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characterisitcis of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportuinites in Technopreneurship - Recent trends.		
Unit-IV	APPLICATIONS OF TECHNOPRENEURSHIP	(9)
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship -- Success Stories of Technopreneurs - Case Studies.		
Unit-V	EMERGING TRENDS IN ENTREPRENERUSHIP	(9)
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneuruship - NGO Entrepreneurship – Recent EntrperneruialDeveloments - Local – National – Global perspectives.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	S.S.Khanka, "Entrepreneurial Development" S.Chand& Co. Ltd. Ram Nagar New Delhi, 2021.
2	Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.

REFERENCES:

1	Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall.
2	Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.
3	Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.

COURSE OUTCOMES:

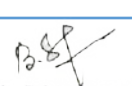
On completion of the course, the students will be able to

CO1:	Learn the basics of Entrepreneurship.
CO2:	Understand the business ownership patterns and environment.
CO3:	Understand the Job opportunitites in Industries relating to Technopreneurship.
CO4:	Learn about applications of tehnpreneurship and successful technopreneurs.
CO5:	Acquaint with the recent and emerging trends in entrepreneurship.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	2	1	-	-	2	2	-
CO2	3	3	3	2	3	2	2	2	2	1	-	3	2	-
CO3	3	3	2	3	3	2	2	2	2	-	-	3	3	-
CO4	3	3	3	3	3	2	2	2	2	2	1	3	3	-
CO5	2	2	2	3	2	3	2	2	2	2	2	2	3	-
Avg.	3	3	3	3	3	2	2	2	2	2	2	3	3	-

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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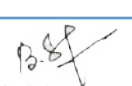


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2408	TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS	L	T	P	C	100
		3	0	0	3	
Course Objectives	•To develop and strengthen the Leadership qualities and motivation of learners. •To impart the Leadership skills and traits essential to become successful entrepreneurs. • To apply the principles and theories of Team Building in managing Technology oriented businessess. •To empower the learners.					

Unit-I	INTRODUCTION TO MANAGING TEAMS	(9)
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.		
Unit-II	MANAGING AND DEVELOPING EFFECTIVE TEAMS	(9)
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.		
Unit-III	INTRODUCTION TO LEADERSHIP.	(9)
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment .		
Unit-IV	LEADERSHIP IN ORGANISATIONS	(9)
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.		
Unit-V	LEADERSHIP EFFECTIVENESS	(9)
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Hughes, R.L., Ginnett, R.C., &Curphy, G.J., Leadership: Enhancing the lessons of experience ,9th Ed, McGraw Hill Education, Chennai, India. (2019).
2	Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, (2015).
3	Halдар, U.K., Leadership and Team Building, Oxford University Press, (2010).
4	Daft, R.L., The Leadership Experience, Cengage, (2015).
5	Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.
6	Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improving team performance, 5thed, Jossey-Bass, (2013).

COURSE OUTCOMES:

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

CO1:	Learn the basics of managing teams for business.
CO2:	Understand developing effective teams for business management.
CO3:	Understand the fundamentals of leadership for running a business.
CO4:	Learn about the importance of leadership for business development.
CO5:	Acquaint with emerging trends in leadership effectiveness for entrepreneurus.”

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				2		3				3	2	
CO2	2	3	3		3	3		3	2		1	2	3	
CO3	3		2			2		2				3	2	
CO4	2	2	3	3	2	2	2	3	2	1	2	2	3	
CO5	2		3	2	2	3	3	3	3	2	3	3	2	
Avg.	3	3	3	3	3	3	3	3	3	2	3	3	3	

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2409	CREATIVITY & INNOVATION IN ENTREPRENEURSHIP	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To develop the creativity skills among the learners • To impart the knowledge of creative intelligence essential for entrepreneurs • To know the applications of innovation in entprerenship. • To develeop innovative business models for business.					

Unit-I	CREATIVITY	(9)
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.		
Unit-II	CREATIVE INTELLIGENCE	(9)
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training-- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.		
Unit-III	INNOVATION.	(9)
Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system.		
Unit-IV	INNOVATION AND ENTREPRENEURSHIP	(9)
Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit.		
Unit-V	INNOVATIVE BUSINESS MODELS	(9)
Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand.
2	Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2004.
3	Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4	Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
5	Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.
6	A. Dale Timpe, Creativity, Jaico Publishing House, 2003.

COURSE OUTCOMES:

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

CO1:	Learn the basics of creativity for developing Entrepreneurship.
CO2:	Understand the importance of creative intelligence for business growth.
CO3:	Understand the advances through Innovation in Industries.
CO4:	Learn about the importance of leadership for business development.
CO5:	Acquaint with developing innovative business models to run the business efficiently and effectively.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				2		2			1	3	2	
CO2	2	3	2		2	3		2	2		2	3	2	
CO3	3	2	3	3	3	2	2	3	2	1	2	3	2	
CO4	2	3	3	3	3	3	2	3	3	2	3	3	3	
CO5	2	2	3	3	3	3	3	3	3	3	3	3	3	
Avg.	3	3	3	3	3	3	3	3	3	2	3	3	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

BSP
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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2410	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs • To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners. • To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.					

Unit-I	INTRODUCTION TO MARKETING MANAGEMENT	(9)
Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.		
Unit-II	MARKETING ENVIRONMENT	(9)
Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.		
Unit-III	PRODUCT AND PRICING MANAGEMENT	(9)
Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.		
Unit-IV	PROMOTION AND DISTRIBUTION MANAGEMENT	(9)
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.		
Unit-V	CONTEMPORARY ISSUES IN MARKETING MANAGEMENT	(9)


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Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.

Total No of Periods to be Taught

45 periods

REFERENCES:

1	Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2	Marketing Management , Philip Kortler and Kevin Lane Keller, PHI 15th Ed, 2015.
3	Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4	Marketing Management- An Indian perspective, Vijay PrakashAnand, Biztantra, Second edition, 2016.
5	Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.
6	Marketing Management- text and Cases, Dr.C.B.Gupta&Dr.N.Rajan Nair, 17th edition, 2016.

COURSE OUTCOMES:

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

CO1:	Have the awareness of marketing management process.
CO2:	Understand the marketing environment.
CO3:	Acquaint about product and pricing strategies.
CO4:	Knowledge of promotion and distribution in marketing management.
CO5:	Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				2		2	2		1	3	2	
CO2	3	3	2	2		2		2	2		2	3	2	
CO3	3	3	3	2	2	2	2	3	2	2	2	3	3	
CO4	2	3	2	2	2	3	2	3	3	2	2	2	3	
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	
Avg.	3	3	3	3	2	3	3	3	3	2	3	3	3	

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2411	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs. - To create an awareness of the roles, functions and functioning of human resource department. - To understand the methods and techniques followed by Human Resource Management practitioners.					

Unit-I	INTRODUCTION TO HRM	(9)
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.		
Unit-II	HUMAN RESOURCE PLANNING	(9)
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends.		
Unit-III	RECRUITMENT AND SELECTION	(9)
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.		
Unit-IV	TRAINING AND EMPLOYEE DEVELOPMENT	(9)
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices.		
Unit-V	CONTROLLING HUMAN RESOURCES	(9)
Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Gary Dessler and BijuVarkkey, Human Resource Management, 14e , Pearson, 2015.
2	Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
3	David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014.
4	R. Wayne Mondy, Human Resource Management, Pearson , 2015.
5	Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012.
6	John M. Ivancevich, Human Resource Management, 12e, McGraw Hill Irwin, 2013.

COURSE OUTCOMES:

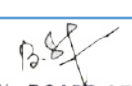
On completion of the course, the students will be able to

CO1:	To understand the Evolution of HRM and Challenges faced by HR Managers.
CO2:	To learn about the HR Planning Methods and practices.
CO3:	To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO4:	To known about the methods of Training and Employee Development.
CO5:	To comprehend the techniques of controlling human resources in organisations.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1		2		2	2	2	2	2	1	
CO2	3	3	2	2	2	2		3	2	2	2	3	2	
CO3	3	3	3	2	2	2		3	3	3	2	3	3	
CO4	2	3	2	2	2	3	1	3	3	3	2	3	2	
CO5	3	3	3	3	2	3	2	3	3	3	3	3	3	
Avg.	3	3	3	3	2	3	3	3	3	2	3	3	3	

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2412	FINANCING NEW BUSINESS VENTURES	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To develop the basics of business venture financing. • To impart the knowledge essential for entrepreneurs for financing new ventures. • To acquaint the learners with the sources of debt and equity financing. • To empower the learners towards fund raising for new ventures effectively.					

Unit-I	ESSENTIALS OF NEW BUSINESS VENTURE	(9)
Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.		
Unit-II	INTRODUCTION TO VENTURE FINANCING	(9)
Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.		
Unit-III	SOURCES OF DEBT FINANCING	(9)
Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.		
Unit-IV	SOURCES OF EQUITY FINANCING	(9)
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.		
Unit-V	METHODS OF FUND RAISING FOR NEW VENTURES	(9)
Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018.
2	Prasanna Chandra, Projects : Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hill Education India Pvt Ltd ,New Delhi , 2019.
3	Introduction to Project Finance. Andrew Fight, Butterworth-Heinemann, 2006
4	R. Wayne Mondy, Human Resource Management, Pearson , 2015.
5	May, John; Simons, Cal. Every Business Needs An Angel: Getting The Money You Need To Make Your Business Grow. Crown Business, 2001.
6	Feld, Brad; Mendelson, Jason. Venture Deals. Wiley, 2011.

COURSE OUTCOMES:

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

CO1:	Learn the basics of starting a new business venture.
CO2:	Understand the basics of venture financing.
CO3:	Understand the sources of debt financing.
CO4:	Understand the sources of equity financing.
CO5:	Acquaint with the methods of fund raising for new business ventures.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2		2	2	1	2	3	2	-
CO2	3	3	3	3	2	2		2	2	1	2	3	3	-
CO3	3	3	3	3	3	2		2	2	2	2	3	3	-
CO4	3	3	3	3	3	2		2	2	2	2	3	3	-
CO5	3	3	3	3	3	3	1	3	3	3	3	3	3	-
Avg.	3	3	3	3	2	3	3	3	3	2	3	3	3	-

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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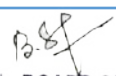


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2413	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce the meaning, nature, and scope of Public Administration and its relevance in contemporary governance and administrative systems. • To provide an understanding of the evolution of Public Administration including traditional, New Public Administration, and New Public Management perspectives. • To examine the relationship between Public Administration and other social sciences, and analyze classical and scientific approaches to administrative theory. • To explore the major administrative approaches such as the bureaucratic, human relations, and ecological approaches, along with their key proponents and impacts. • To understand essential administrative functions including leadership, communication, and decision-making processes and techniques in public administration.					

Unit-I	FUNDAMENTALS OF PUBLIC ADMINISTRATION	(9)
1. Meaning, Nature and Scope of Public Administration. 2. Importance of Public Administration. 3. Evolution of Public Administration.		
Unit-II	CONTEMPORARY APPROACHES TO PUBLIC ADMINISTRATION	(9)
1. New Public Administration. 2. New Public Management. 3. Public and Private Administration.		
Unit-III	THEORETICAL FOUNDATIONS AND INTERDISCIPLINARY PERSPECTIVES	(9)
1. Relationships with Political Science, History and Sociology. 2. Classical Approach. 3. Scientific Management Approach.		
Unit-IV	ADMINISTRATIVE APPROACHES AND THINKERS	(9)
1. Bureaucratic Approach: Max Weber. 2. Human Relations Approach : Elton Mayo. 3. Ecological Approach : Riggs.		
Unit-V	ADMINISTRATIVE SKILLS AND DECISION-MAKING PROCESSES	(9)
1. Leadership: Leadership - Styles – Approaches. 2. Communication: Communication Types - Process – Barriers. 3. Decision Making: Decision Making - Types, Techniques and Processes.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Avasthi and Maheswari: Public Administration in India, Agra:LakshmiNarain Agarwal,2013.
2	Ramesh K Arora: Indian Public Administration, New Delhi: WishwaPrakashan, 2012.
3	R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
4	RumkiBasu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
5	R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

COURSE OUTCOMES:

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

CO1:	Understand the meaning, nature, scope, importance, and historical evolution of Public Administration.
CO2:	Explain the concepts and developments in New Public Administration and New Public Management, and compare with private administration.
CO3:	Analyze the interdisciplinary nature of Public Administration and classical theories including Scientific Management.
CO4:	Evaluate the relevance of key administrative approaches such as Bureaucratic, Human Relations, and Ecological theories.
CO5:	Apply leadership, communication, and decision-making principles in the context of public administration.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				2		2	1		1	2	1	
CO2	3	3			2	2		2	2		1	2	1	
CO3	3	3	2			2		2	2		2	3	2	
CO4	3	3	3			2		2	2		2	3	2	
CO5	2	2	3	2		3	1	3	3	2	2	3	2	
Avg.	3	3	3	3	2	3	3	3	3	2	3	3	3	

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2414	CONSTITUTION OF INDIA	L	T	P	C	100
		3	0	0	3	

Course Objectives	- To provide foundational knowledge of the constitutional development in India from 1909 to 1947 and the making of the Indian Constitution. - To familiarize students with the core features of the Constitution including Fundamental Rights, Duties, and Directive Principles of State Policy. - To understand the structure and functioning of the Union Government – President, Parliament, and the Supreme Court. - To explore the federal structure by analyzing the role and powers of the Governor, State Legislature, and High Courts. - To develop awareness about the constitutional principles of secularism, social justice, and the rights and safeguards for minorities in India.
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Unit-I	HISTORICAL BACKGROUND AND MAKING OF THE INDIAN CONSTITUTION	(9)
1. Meaning, Nature and Scope of Public Administration. 2. Importance of Public Administration. 3. Evolution of Public Administration.		
Unit-II	FUNDAMENTAL RIGHTS, DUTIES, AND DIRECTIVE PRINCIPLES OF STATE POLICY	(9)
1. Fundamental Rights 2. Fundamental Duties 3. Directive Principles of State Policy.		
Unit-III	THE PRESIDENT, PARLIAMENT, AND SUPREME COURT OF INDIA	(9)
1. President 2. Parliament 3. Supreme Court.		
Unit-IV	GOVERNOR, STATE LEGISLATURE, AND HIGH COURT	(9)
1. Governor. 2. State Legislature. 3. High Court.		
Unit-V	SECULARISM, SOCIAL JUSTICE, AND MINORITY SAFEGUARDS	(9)
1. Secularism. 2. Social Justice. 3. Minority Safeguards.		

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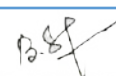


Total No of Periods to be Taught	45 periods
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REFERENCES:	
1	Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi.
2	Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.
3	Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi.
4	Agarwal R.C: Indian Political System; S.Chand& Co., New Delhi.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Understand the historical development of the Indian Constitution from 1909 to 1947, including the framing process and role of the Constituent Assembly.
CO2:	Explain the significance and provisions of Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy.
CO3:	Analyze the structure, powers, and functions of the President, Parliament, and Supreme Court of India.
CO4:	Describe the roles and responsibilities of the Governor, State Legislature, and High Courts within the Indian federal system.
CO5:	Evaluate the constitutional principles of secularism, social justice, and the safeguards provided for minorities in India.

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2						2	1		1	3	2	
CO2	3	3						2	1		2	3	2	
CO3	3	3	2					2	2		2	3	3	
CO4	3	2	2					2	2		2	3	3	
CO5	3	3	3	2		2		3	3	2	2	3	3	
Avg.	3	3	3	2	2	2		3	3	2	2	3	3	
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom’s Taxonomy														


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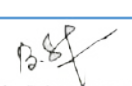


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2415	PUBLIC PERSONNEL ADMINISTRATION	L	T	P	C	100
Course Objectives	• To understand the meaning, scope, and importance of personnel administration and its systems. • To examine the roles of generalists, specialists, and civil servants in relation to the political executive. • To explore recruitment methods, training types, and promotion practices in public administration. • To analyze the structure, functions, and service conditions of All India Services and State Public Service Commissions. • To study employer-employee relations, wage systems, and employee benefits in public administration.					

Unit-I	INTRODUCTION TO PERSONNEL ADMINISTRATION	(9)
1. Meaning, Scope and Importance of Personnel Administration. 2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems.		
Unit-II	ROLES AND ETHICS IN PERSONNEL ADMINISTRATION	(9)
1. Meaning, Scope and Importance of Personnel Administration. 2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems.		
Unit-III	PERSONNEL DEVELOPMENT AND CAREER MANAGEMENT	(9)
1. Recruitment: Direct Recruitment and Recruitment from Within 2. Training: Kinds of Training 3. Promotion.		
Unit-IV	PUBLIC SERVICE STRUCTURE AND REGULATORY BODIES	(9)
1. All India Services 2. Service Conditions 3. State Public Service Commission.		
Unit-V	EMPLOYEE RELATIONS AND COMPENSATION MANAGEMENT	(9)
1. Employer Employee Relations. 2. Wage and Salary Administration. 3. Allowances and Benefits.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Stahl Glean O: Public Personnel Administration.
2	ParnandikarPai V.A: Personnel System for Development Administration.
3	Bhambhiru . P: Bureaucracy and Policy in India.
4	Dwivedi O.P and Jain R.B: India's Administrative state.
5	Muttalis M.A: Union Public Service Commission.
6	BhakaraRao .V: Employer Employee Relations in India

COURSE OUTCOMES:

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

CO1:	Understand the meaning, scope, importance, and types of personnel systems in public administration.
CO2:	Analyze the roles of generalists and specialists, and evaluate the ethical relationship between civil servants and political executives.
CO3:	Explain the processes of recruitment, training, and promotion in personnel administration.
CO4:	Examine the structure, roles, and functions of the All India Services and State Public Service Commissions, including service conditions.
CO5:	Evaluate employer-employee relations, wage and salary administration, and the system of allowances and benefits in public sector employment.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	0	0	0	0				3	2	
CO2	3	3	2	2	1	1	0	0				3	2	
CO3	3	3	3	2	1	1	0	0				3	3	
CO4	2	3	3	2	2	1	1	0				2	3	
CO5	2	2	2	3	3	2	1	1				2	3	
Avg.	3	3	3	3	3	2	1	1				3	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2416	ADMINISTRATIVE THEORIES	L	T	P	C	100
Course Objectives	- To understand the meaning, scope, significance, and historical evolution of Public Administration as a discipline.. - To study major organizational theories including Scientific Management, Classical, and Human Relations theories. - To analyze organizational goals, behavior, group dynamics, and organizational design principles. - To examine various motivation and leadership theories along with decision-making processes and techniques. - To learn about key administrative thinkers and their contributions to the field of Public Administration.					

Unit-I	INTRODUCTION TO PUBLIC ADMINISTRATION: MEANING, SCOPE, SIGNIFICANCE, AND EVOLUTION	(9)
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration.		
Unit-II	THEORIES OF ORGANIZATION: SCIENTIFIC MANAGEMENT, CLASSICAL, AND HUMAN RELATIONS THEORIES	(9)
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory.		
Unit-III	ORGANIZATIONAL GOALS, BEHAVIOR, GROUP DYNAMICS, AND DESIGN	(9)
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.		
Unit-IV	MOTIVATION, LEADERSHIP THEORIES, AND DECISION-MAKING PROCESSES	(9)
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making.		
Unit-V	CONTRIBUTIONS OF ADMINISTRATIVE THINKERS	(9)
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	CrozierM : The Bureaucratic phenomenon (Chand).
2	Blau. P.M and Scott. W : Formal Organizations (RKP).
3	Presthus. R : The Organizational Society (MAC).
4	Dwivedi O.P and Jain R.B: India's Administrative state.
5	Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
6	Keith Davis : Organization Theory (MAC).

COURSE OUTCOMES:

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

CO1:	Understand the scope, significance, and evolution of Public Administration as a discipline.
CO2:	Explain key organizational theories including Scientific Management, Classical, and Human Relations.
CO3:	Analyze organizational goals, behavior, group dynamics, and design.
CO4:	Evaluate motivation and leadership theories, and apply decision-making techniques.
CO5:	Assess the contributions of major administrative thinkers to the field of Public Administration.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1					3	2	
CO2	3	2	1	1	1	1	1					3	3	
CO3	2	3	2	1	2	2	1					2	3	
CO4	2	3	2	2	3	3	2					2	3	
CO5	3	3	2	2	2	2	1					3	3	
Avg.	3	3	2	2	3	3	2					3	3	

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2417	INDIAN ADMINISTRATIVE SYSTEM	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the evolution and constitutional framework of Indian Administration. - To learn about the structure and functioning of district and local administration. - To examine the key features of the 73rd and 74th Constitutional Amendments. - To explore the effects of coalition politics and administrative vigilance mechanisms. - To gain knowledge about anti-corruption institutions like Lokpal and Lokayukta.					

Unit-I	CONSTITUTIONAL FRAMEWORK AND AUTHORITIES IN INDIAN ADMINISTRATION	(9)
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India.		
Unit-II	DISTRICT ADMINISTRATION AND LOCAL GOVERNANCE	(9)
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government		
Unit-III	PANCHAYATI RAJ AND URBAN LOCAL GOVERNANCE: 73RD AND 74TH CONSTITUTIONAL AMENDMENTS	(9)
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992.		
Unit-IV	COALITION POLITICS, INTEGRITY, AND VIGILANCE IN INDIAN ADMINISTRATION	(9)
Coalition politics in India, Integrity and Vigilance in Indian Administration.		
Unit-V	CORRUPTION AND ANTI-CORRUPTION INSTITUTIONS	(9)
Corruption – Ombudsman, Lok Pal & LokAyuktha.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	S.R. Maheswari : Indian Administration.
2	Khera. S.S : Administration in India.
3	Ramesh K. Arora : Indian Public Administration.
4	T.N. Chaturvedi : State administration in India.
5	Basu, D.D : Introduction to the Constitution of India.

COURSE OUTCOMES:

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

CO1:	Understand the evolution and constitutional framework of Indian administration and key constitutional authorities.
CO2:	Explain the roles of district administration and local government officials in governance and development.
CO3:	Analyze the features and impacts of the 73rd and 74th Constitutional Amendments on local self-government.
CO4:	Evaluate coalition politics, integrity, and vigilance in Indian administration.
CO5:	Assess anti-corruption mechanisms including Ombudsman, Lok Pal, and LokAyuktha.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1						3	2	
CO2	3	2	1	1	1	1						3	3	
CO3	2	3	2	1	2	2						2	3	
CO4	2	3	2	2	3	3						2	3	
CO5	3	3	2	2	2	2						3	3	
Avg.	3	3	2	2	3	3						3	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2418	PUBLIC POLICY ADMINISTRATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce the concept and significance of Public Policy. • To familiarize students with various approaches to policy analysis. • To understand the policy-making process. • To explore the institutional and political framework of policy-making. • To provide insight into specific public policies.					

Unit-I	FOUNDATIONS OF PUBLIC POLICY	(9)
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.		
Unit-II	APPROACHES TO POLICY ANALYSIS	(9)
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model.		
Unit-III	STAGES OF THE POLICY-MAKING PROCESS	(9)
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.		
Unit-IV	INSTITUTIONAL FRAMEWORK OF PUBLIC POLICY-MAKING	(9)
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.		
Unit-V	INTRODUCTION TO KEY PUBLIC POLICIES IN INDIA	(9)
Introduction to the following Public Policies – New Economic Policy – Population Policy –Agriculture policy - Information Technology Policy.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Rajesh Chakrabarti&KaushikSanyal : Public Policy in India, Oxford University Press, 2016.
2	KuldeepMathur : Public Policy and Politics in India, Oxford University Press, 2016.
3	BidyutvChakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4	PradeepSaxena : Public Policy Administration and Development
5	Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.

COURSE OUTCOMES:

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

CO1:	Explain the meaning, nature, scope, and importance of public policy and its relationship with social sciences.
CO2:	Analyze various approaches to policy analysis including institutional, incremental, systems, and Dror's optimal model.
CO3:	Describe and evaluate the major stages in the public policy-making process—formulation, implementation, and evaluation.
CO4:	Examine the roles of bureaucracy, interest groups, and political parties in the institutional framework of policy-making.
CO5:	Demonstrate an understanding of key public policies in India, including economic, population, agriculture, and IT policies.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	3	0	2	0							3	3	
CO2	3	3	2	0	0							3	3	
CO3	3	3	2	2	0							3	3	
CO4	3	3	0	2	2							3	3	
CO5	3	3	2	2	2							3	3	
Avg.	3	3	2	2	2							3	3	

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy

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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2419	STATISTICS FOR MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To learn the applications of statistics in business decision making.					

Unit-I	INTRODUCTION	(9)
Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.		
Unit-II	SAMPLING DISTRIBUTION AND ESTIMATION	(9)
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.		
Unit-III	TESTING OF HYPOTHESIS - PARAMETIRC TESTS	(9)
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.		
Unit-IV	NON-PARAMETRIC TESTS	(9)
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.		
Unit-V	CORRELATION AND REGRESSION	(9)
Correlation –Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Richard I. Levin, David S. Rubin, Masood H. Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2	Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
3	T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
4	Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
5	David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James J. Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.

COURSE OUTCOMES:

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

CO1:	To facilitate objective solutions in business decision making.
CO2:	To understand and solve business problems.
CO3:	To apply statistical techniques to data sets, and correctly interpret the results.
CO4:	To develop skill-set that is in demand in both the research and business environments.
CO5:	To enable the students to apply the statistical techniques in a work setting.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	0							3	2	
CO2	3	3	3	1	0							3	3	
CO3	3	3	3	2	1							3	3	
CO4	3	3	3	2	1							2	3	
CO5	3	3	3	2	1							3	3	
Avg.	3	3	3	2	1							3	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name				121-BE- BME
Semester						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2420	DATAMINING FOR BUSINESS INTELLIGENCE	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To know how to derive meaning form huge volume of data and information. - To understand how knowledge discovering process is used in business decision making.					

Unit-I	INTRODUCTION	(9)
Data mining, Text mining, Web mining, Data ware house.		
Unit-II	DATA MINING PROCESS	(9)
Data mining process – KDD, CRISP-DM, SEMMA Prediction performance measures		
Unit-III	PREDICTION TECHNIQUES	(9)
Data visualization, Time series – ARIMA, Winter Holts,		
Unit-IV	CLASSIFICATION AND CLUSTERING TECHNIQUES	(9)
Classification, Association, Clustering.		
Unit-V	MACHINE LEARNING AND AI	(9)
Genetic algorithms, Neural network, Fuzzylogic, AntColony optimization, Particle Sparm optimization		
Total No of Periods to be Taught		45 periods

REFERENCES:	
1.	1. JaiweiHamandMichelineKamber, DataMiningconceptsand techniques, Kauffmann Publishers 2006
2.	Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3.	W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.
4.	Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
5.	Michel Berry and Gordon Linoft, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6.	.Michel Berry and Gordon Linoft, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
7.	G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011

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COURSE OUTCOMES:

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

CO1:	Learn to apply various data mining techniques into various areas of different domains.
CO2:	Be able to interact competently on the topic of data mining for business intelligence.
CO3:	Apply various prediction techniques.
CO4:	Learn about supervised and unsupervised learning technique.


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
CMG2421	HUMAN RESOURCE ANALYTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy. - To know the different types of HR metrics and understand their respective impact and application. - To understand the impact and use of HR metrics and their connection with HR analytics. - To understand common workforce issues and resolving them using people analytics.					

Unit-I	INTRODUCTION TO HR ANALYTICS	(9)
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.		
Unit-II	HR ANALYTICS I: RECRUITMENT	(9)
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.		
Unit-III	HR ANALYTICS - TRAINING AND DEVELOPMENT	(9)
Training & Development Metrics : Percentage of employees trained- Internally and externally trained - Training hours and cost per employee - ROI		
Unit-IV	HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER	(9)
Employee Engagement Metrics : Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.		
Unit-V	HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT	(9)
Employee Engagement Metrics : Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	JacFitzenz , The New HR Analytics, AMACOM , 2010.
2	Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.
3	Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003
4	Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and Applications, SAGE Publications India ,2017.
5	Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.
6	Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014.

COURSE OUTCOMES:

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

CO1:	The learners will be conversant about HR metrics and ready to apply at work settings.
CO2:	The learners will be able to resolve HR issues using people analytics


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2422	MARKETING AND SOCIAL MEDIA WEB ANALYTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To showcase the opportunities that exist today to leverage the power of the web and social media.					

Unit-I	MARKETING ANALYTICS	(9)
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis		
Unit-II	COMMUNITY BUILDING AND MANAGEMENT	(9)
History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media.		
Unit-III	SOCIAL MEDIA POLICIES AND MEASUREMENTS	(9)
Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.		
Unit-IV	WEB ANALYTICS	(9)
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.		
Unit-V	SEARCH ANALYTICS	(9)
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization		
Total No of Periods to be Taught		45 periods

REFERENCES:

1	K. M. Shrivastava, SocialMedia inBusiness andGovernance, SterlingPublishers Private Limited, 2013
2	Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
3	Bittu Kumar, Social Networking, V & S Publishers, 2013

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4	AvinashKaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007
5	Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and Café Press 2004
6	Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016

COURSE OUTCOMES:

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

CO1:	The Learners will understand social media, web and social media analytics and their potential impact.
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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2423	OPERATION AND SUPPLY CHAIN ANALYTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.					

Unit-I	INTRODUCTION	(9)
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains–Basics, transforming supply chains.		
Unit-II	WAREHOUSING DECISIONS	(9)
P-Median Methods-Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.		
Unit-III	INVENTORY MANAGEMENT	(9)
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.		
Unit-IV	TRANSPORTATION NETWORK MODELS	(9)
Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Sales man Problem, Scheduling Algorithms.		
Unit-V	MCDM MODELS	(9)
Analytic Hierarchy Process (AHP), Data Envelopment Analysis(DEA), Fuzzy Logic and Techniques, the analytical network process(ANP),TOPSIS.		
Total No of Periods to be Taught		45

REFERENCES:

1	Nada R. Sanders, Big data driven supply chain management: A frame work for implementing analytic and turning information into intelligence, Pearson Education, 2014.
2	Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jaya raman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013


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3	Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4	Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management, I.K. International Publishing House Pvt. Ltd., 2016.
5	Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

COURSE OUTCOMES:

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

CO1:	To Enable Quantitative Solutions in Business Decision Making Under Conditions Of certainty, risk and uncertainty.
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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCMG2424	FINANCIAL ANALYTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	This course introduces a core set of modern analytical tools that specifically target finance applications.					

Unit-I	CORPORATE FINANCE ANALYSIS	(9)
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.		
Unit-II	FINANCIAL MARKET ANALYSIS	(9)
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.		
Unit-III	PORTFOLIO ANALYSIS	(9)
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.		
Unit-IV	TECHNICAL ANALYSIS	(9)
Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.		
Unit-V	CREDIT RISK ANALYSIS	(9)
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.		
Total No of Periods to be Taught		45 periods

REFERENCES:

1	Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.
2	Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.
3	Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.
4	Python for Finance - Paperback – Import, 30 Jun 2017 by Yuxing Yan (Author).

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5	Mastering Python for Finance Paperback – Import, 29 Apr 2015 by James Ma Weiming.
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COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	The learners should be able to perform financial analysis for decision making using excel, Python and R.


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VERTICAL5: ENVIRONMENT AND SUSTAINABILITY

Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2425	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.					

Unit-I	SUSTAINABLE DEVELOPMENT GOALS	(9)
Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.		
Unit-II	SUSTAINABLE INFRASTRUCTURE PLANNING	(9)
Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement & Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).		
Unit-III	SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES	(9)
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.		


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Unit-IV	SUSTAINABLE CONSTRUCTION MATERIALS	(9)
Construction materials: Concrete, steel, glass, aluminium, timber and FRP- No/Low cement concrete - Recycled and manufactured aggregate- Role of QC and durability- Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility– Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme- Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies		
Unit-V	SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS	(9)
Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .		
Total No of Periods to be Taught		45 periods

REFERENCES:	
1	Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2	Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016
3	Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4	William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5	New Building Materials and Construction World magazine
6	Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher:Belhaven Press,ISBN:1852930039.
7	Munier N, "Introduction to Sustainability", Springer 2005
8	Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
9	Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing, 2009


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10	European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010
11	Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).

COURSE OUTCOMES:

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

CO1:	Understand the environment sustainability goals at global and Indian scenario.
CO2:	Understand risks in development of projects and suggest mitigation measures.
CO3:	Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4:	Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5:	Explain the new technologies for maintenance of infrastructure projects.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2		1	1		2	3	1	1		2	1	1	2
CO2	3	1	3	2	1	2	2		1	1	1	2	2	2
CO3	2	2	3	1	1	1	1				1	1	1	3
CO4	3	1	3	2	2	1	3	1	1	1	1	2	2	2
CO5	3	1	2	2	2	2	3	1		1	1	2	2	3
Avg.	3	1	3	2	2	2	3	1	1	1	1	2	2	3

1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2426	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To educate the students about the issues of sustainability in agro eco systems, introduce the concepts and principles of agro ecology as applied to the design and management of sustainable agricultural systems for a changing world.					

Unit-I	AGROECOLOGY, AGROECOLOGY, AND SUSTAINABLE CONCEPTS	(9)
Ecosystem definition - Biotic Vs. a biotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture-Problems associated with industrial agriculture/food systems- Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems		
Unit-II	SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT	(9)
Soil health definition-Factors to consider(physical, chemical and biological)-Composition of healthy soils-Soil erosion and possible control measures- Techniques to build healthy soil- Management practices for improving soil nutrient-Ecologically sustainable strategies for pest and disease control		
Unit-III	WATER MANAGEMENT	(9)
Soil water storage and availability-Plant yield response to water -Reducing evaporation in agriculture-Earth works and tanks for rain water harvesting-Options for improving the productivity of water-Localized irrigation -Irrigation scheduling-Fertigation-Advanced irrigation systems and agricultural practices for sustainable water use		
Unit-IV	ENERGY AND WASTE MANAGEMENT	(9)
Types and sources of agricultural wastes-Composition of agricultural wastes-Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes-Renewable energy for sustainable agriculture		
Unit-V	EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS	(9)
Indicators of sustainability in agriculture-On-farm evaluation of agro ecosystem sustainability- Alternative agriculture approaches/farming techniques for sustainable food production-Goals and components of a community food system-Case studies		
Total No of Periods to be Taught		45 periods

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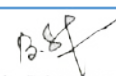
REFERENCES:

1	Approaches to Sustainable Agriculture–Exploring the Path ways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2	Natural bio active products in sustainable agriculture, Singh, J. & Yadav, A. N., Springer, 2020
3	Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
4	Principles of Agronomy for Sustainable Agriculture, Villalobos, F. J. & Fereres, E., Springer, 2016
5	Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021

COURSE OUTCOMES:

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

CO1:	The student is expected to be able to Have a depth knowledge about the concepts, principles and advantages of sustainable agriculture
CO2:	Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
CO3:	Suggest the ways to optimize the use of water in agriculture top roomteam ecological use of resources
CO4:	Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
CO5:	Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the red sign of a conventional agro ecosystem


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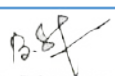


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2427	SUSTAINABLE BIO MATERIALS	L	T	P	C	100
		3	0	0	3	
Course Objectives	● To Impart knowledge of bio materials and their properties ● To learn about Fundamentals aspects of Biopolymers and their applications ● To learn about bio ceramics and biopolymers ● To introduce the students about metals as biomaterials and their usage a simplants ● To make the students understand the significance of bio nanomaterials and its applications.					

Unit-I	INTRODUCTION TO BIOMATERIALS	(9)
Introduction: Definition of biomaterials, requirements & classification of biomaterials – Types of Biomaterials-Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types-crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials-strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials		
Unit-II	BIO POLYMERS	(9)
Molecular structure of polymers-Molecular weight- Types of polymerization techniques-Types of polymerization reactions-Physical states of polymers-Common polymeric biomaterials- Polyethylene-Polymethylmeth crylate(PMMA-Polylactic acid(PLA)and polyglycolic acid(PGA)- Polycaprolactone (PCL)- Other bio degradable polymers-Polyurethan-reactions polymers for medical purposes-Collagens-Elastin-Cellulose and derivatives-Synthetic polymeric membranes and their biological applications		
Unit-III	BIO CERAMICS AND BIOCOMPOSITES	(9)
General properties-Bio ceramics-Silicate glass-Alumina (Al_2O_3)-Zirconia(ZrO_2)-Carbon- Calcium phosphates(CaP)-Resorbable Ceramics-surface reactive ceramics-Biomedical Composites-Polymer Matrix Composite (PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite(MMC)-glass ceramics- Ortho pedic implants-Tissue engineering scaffolds		
Unit-IV	METALS AS BIOMATERIALS	(9)
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)-magnesium-based biodegradable alloys-surface properties of metal implants for osteo integration-medical application-corrosion of metallic implants-biological tolerance of implant metals		
Unit-V	NANOBIOMATERIALS	(9)


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Meatllc nano biomaterials–Nano polymers-Nano ceramics-Nano composites-Carbon based nano biomaterials - transport of nanoparticles- release rate-positive and negative effect of nano size-nano fibres-Nano and micro features and their importance in implant performance- Nano surface and coats- Applications nano anti biotics-Nano medicines-Biochips–Biomimetics- Bio NEMs-Biosensor- Bioimaging/Molecular Imaging-challenges and future perspective.

Total No of Periods to be Taught

45 periods

REFERENCES:

- 1 C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, GopinathMani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press,2014.
- 2 Donglushi“Introductionto Biomaterials” Tsinghua University press, 2006
- 3 JoonPark,R.S.Lakes“BiomaterialsAn Introduction” third edition,Springer2007.
- 4 M.Jaffe, W.Hammond, P.Tolias and T.Arinzeh“Characterization of Biomaterials” Wood head publishing, 2013.
- 5 BuddyD.RatnerandAllanS.HoffmanBiomaterialsScience“AnIntroductiontoMaterialinMedicine” ThirdEdition,2013.
- 6 VasifHasirci,NesrinHasirci“Fundamentals of Bio materials”Springer, 2018
- 7 LeopoidoJavierRiosGonzalez.“HandbookofResearchonBioenergyandBiomaterials: Consolidated and greenprocess” Apple academicpress, 2021.
- 8 DevarajanThangadurai,JeyabalanSangeetha,RamPrasad“Functional Bio nanomaterials”springer, 2020.
- 9 Sujata.V.BhatBiomaterials;Narosa Publishinghouse,2002.

COURSE OUTCOMES:

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

- | | |
|------|--|
| CO1: | Students will gain familiarity with Bio materials and they will understand their importance. |
| CO2: | Students will get an overview of different biopolymers and their properties |
| CO3: | Students gain knowledge on some of the important Bio ceramics and Bio composite materials |
| CO4: | Students gain knowledge on metals as biomaterials |
| CO5: | Student gains knowledge on the importance of nanobio materials in biomedical applications. |


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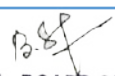


Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2428	MATERIALS FOR ENERGY SUSTAINABILITY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To familiarize the students about the challenges and demands of energy sustainability • To provide fundamental knowledge about electrochemical devices and the materials used. • To introduce the students to various types of fuel cell • To enable students to appreciate novel materials and their usage in photovoltaic application • To introduce students to the basic principles of various types Super capacitors and the materials used					

Unit-I	SUSTAINABLE ENERGY SOURCES	(9)
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India-centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy		
Unit-II	ELECTRO CHEMICAL DEVICES	(9)
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O ₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO ₂ , LiFePO ₄ , LiMn ₂ O ₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)		
Unit-III	FUEL CELLS	(9)
Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxides supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and mono polar plates).		
Unit-IV	PHOTO VOLTAIS	(9)


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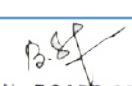
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Physicsofthesolarcell–Theoreticallimitsofphotovoltaicconversion–bulkcrystal growthofSi and wafering for photo voltaicapplication– Crystallinesiliconsolarcells–thinfilmsiliconsolarcells–multijunctionsolarcells–amorphoussiliconbasedsolarcells– photovoltaicconcentrators– Cu(InGa)Se2 solarcells–CadiumTelluridesolarcells–dyesensitizedsolarcells–Perovskitesolarcells– Measurementandcharacterizationofsolarcells–Materialsusedinsolarcells(metallicoxides,CNTfilms,graphene,OD fullerenes,single-multiwalledcarbonnanotubes,two-dimensional Graphene, organic orSmall molecule-basedsolarcellsmaterials-copper-phthalocyanineandperylene-tetracarboxylicbis-benzene–fullerenes-boronsubphthalocyanine-tin (II)phthalocyanine		
Unit-V	SUPER CAPACITORS	(9)
Super capacitor –typesofsuper capacitors (electro staticdouble-layercapacitors,pseudocapacitors and hybrid capacitors) - design of super capacitor-three and two electrode cell-parametersof super capacitor-Faradaicandnon-Faradaiccapacitance–electrode materials(transitionmetal oxides(MO),mixed metal oxides,conductingpolymers(CP),Mxenes,nanocarbons,non-noble metal,chalcogenides,hydroxidesand1D-3Dmetal-organic framework(MOF),activatedcarbon fibres (ACF)-Hydroxides-BasedMaterials– Poly aniline (PANI),aternary hybridcomposite- conductivepoly pyrrolehydro gels–Different typesofnanocomposites fortheSCElectrodes (carbon–carbon composites,carbon-MOs composites,carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides,andnitrides.		
Total No of Periods to be Taught		45 periods

REFERENCES:	
1	Functional materialsfor sustainable energy applications; John A. Kilner, StephenJ.Skinner,StuartJ.C. Irvineand Peter P.Edwards.
2	HandBookofFuelCells:FuelCellTechnologyandApplications,WolfVielstich,ArnoldLamm,Hubert AndreasGasteiger, Harumi Yokokawa,Wiley,London2003.
3	B.E.Conway,Electrochemicalsupercapacitors: scientific fundamentals andtechnological applications,KluwerAcademic/Plenumpublishers, NewYork,1999.
4	T.R.Crompton, Batteriesreference book,Newners,3rd Edition, 2002.
5	MaterialsforSupercapacitorapplications;B.Viswanathan. M.AuliceScibioh
6	Electrode Materials for Supercapacitors: A Review of Recent Advances, ParniaForouzandeh,VigneshKumaravel and Suresh C.Pillai,catalysts2022
7	Recentadvances,practical challenges,andperspectivesofintermediate temperaturesolid oxide fuel cell cathodesAmanda Ndubuisi,SaraAbouali,KalpanaSingh and VenkataramanThangadurai,J.Mater.Chem. A, 2022.
8	Reviewofnextgenerationphotovoltaicsolarcelltechnologyandcomparativematerialistic developmentNeerajKant, PushpendraSingh,MaterialsToday:Proceedings,2022


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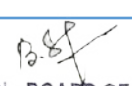
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COURSE OUTCOMES:

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

CO1:	Students will acquire knowledge about energy sustainability.
CO2:	Students understand the principles of different electrochemical devices.
CO3:	Students learn about the working of fuel cells and their application.
CO4:	Students will learn about various Photovoltaic applications and the materials used.
CO5:	The students gain knowledge on different types of super capacitors and the performance of various materials


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2429	GREEN TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability. - To provide green engineering solutions to energy demand, reduced energy footprint.					

Unit-I	PRINCIPLES OF GREEN CHEMISTRY	(9)
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.		
Unit-II	POLLUTION TYPES	(9)
Pollution-types, causes, effects, and abatement. Waste-sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.		
Unit-III	GREEN REAGENTS AND GREEN SYNTHESIS	(9)
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions		
Unit-IV	DESIGNING GREEN PROCESSES	(9)
Safe design, process intensification, in process monitoring. Safe product and process design- Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention		
Unit-V	GREEN NANOTECHNOLOGY	(9)
Nano materials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology		
Total No of Periods to be Taught		45 periods

TEXT BOOK:

1	Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
2	Green Chemistry – An introductory text- M. Lancaster, RSC, 2016

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3	Greenchemisrmetryrics- Alexi Lapkinanddavid Constable (Eds),Wileypublications,2008
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REFERENCES:

1	Environmental chemistry,StanleyE Manahan, Taylorand Francis,2017
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COURSE OUTCOMES:

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

CO1:	Tounderstandtheprinciples of greenengineering andtechnology
CO2:	Tolearn aboutpollution usinghazardous chemicalsandsolvents
CO3:	Tomodifyprocesses and productstomakethem green andsafe.
CO4:	Todesignprocesses and productsusinggreen technology
CO5:	To understandadvanced technology ingreensynthesis


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2430	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity. - To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.					

Unit-I	ENVIRONMENTAL MONITORING AND STANDARDS	(9)
Introduction- Environmental Standards-Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India-Ambient air quality standards-water quality standard-Environmental Monitoring-Need for environmental monitoring-Concepts of environmental monitoring-Techniques of Environmental Monitoring.		
Unit-II	MONITORING OF ENVIRONMENTAL PARAMETERS	(9)
Current Environmental Issues-Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring-Atmospheric Monitoring-screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.		
Unit-III	ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING	(9)
Classification of Instrumental Method-Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)-Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis		
Unit-IV	ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT	(9)
Water quality monitoring programme-national water quality monitoring-Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment-hazard identification-exposure assessment-dose-response assessment; risk characterization.		
Unit-V	AUTOMATED DATA ACQUISITION AND PROCESSING	(9)
Data Acquisition for Process Monitoring and Control-The Data Acquisition System- Online Data Acquisition, Monitoring, and Control-Implementation of a Data Management System-Review of Observational Networks-Sensors and transducers- classification of transducers-data acquisition system-types of data acquisition systems- data management and quality control; regulatory overview.		
Total No of Periods to be Taught		45 periods


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TEXT BOOK:

1	Environmental monitoring Handbook, FrankR. Burden, ©2002 by The McGraw-Hill Companies, Inc.
2	Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes/Pradyot Patnaik, ©1997 by CRC Press, Inc

REFERENCES:

1	Environmental monitoring / edited by G. Bruce Wiersma, ©2004 by CRC Press LLC.
2	H.H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3	Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

COURSE OUTCOMES:

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

CO1:	Basic concepts of environmental standards and monitoring.
CO2:	The ambient air quality and water quality standards;
CO3:	The various instrumental methods and their principles for environmental monitoring
CO4:	The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5:	Know the standard research methods that are used worldwide for monitoring the environment.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	3	-
CO2	1	1	1	1	1	-	-	-	1	-	2	2	2	1
CO3	1	1	2	1	1	-	-	-	2	-	1	1	1	-
CO4	1	2	3	3	1	-	-	-	2	-	3	3	1	-
CO5	3	1	3	2	1	-	-	-	3	-	3	1	2	-
Avg.	3	2	3	3	2	-	-	-	3	-	3	3	3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy


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Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES243 1	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To create awareness on the energy scenario of India with respect to world • To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilization • Familiarisation on the concept of sustainable development and its benefits • Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development • Acquainting with energy policies and energy planning for sustainable development					

Unit-I	ENERGY SCENARIO	(9)
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T & D losses, energy demand, per capita energy consumption) – energy pricing – Energy security		
Unit-II	ENERGY AND ENVIRONMENT	(9)
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls		
Unit-III	SUSTAINABLE DEVELOPMENT	(9)
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG)- Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.		
Unit-IV	RENEWABLE ENERGY TECHNOLOGY	(9)
Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits		
Unit-V	ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	(9)
National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Roadmap for ethanol blending, Energy Efficiency and Energy Mix		
Total No of Periods to be Taught		45 periods


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REFERENCES:

1	Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004
2	Robert Ristiri and Jack P. Kraushaar, "Energy and the environment", Wiley, 2005.
3	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
4	Twidell, J.W. & Weir A., "Renewable Energy Resources", EFN Spon Ltd., UK, 2015.
5	Dhandapani Alagiri, "Energy Security in India Current Scenario", The ICF AI University Press, 2006.

COURSE OUTCOMES:

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

CO1:	Understand the world and Indian energy scenario
CO2:	Analyse energy projects, its impact on environment and suggest control strategies
CO3:	Recognise the need of Sustainable development and its impact on human resource development
CO4:	Apply renewable energy technologies for sustainable development
CO5:	Fathom Energy policies and planning for sustainable development.


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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B

Mecheri, Salem Dt-636453, Tamilnadu



Department	BME	Programme Code & Name	121-BE- BME
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCES2432	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the types of energy sources, energy efficiency and environmental implications of energy utilization - To create awareness on energy audit and its impacts - To acquaint the techniques adopted for performance evaluation of thermal utilities - To familiarize on the procedures adopted for performance evaluation of electrical utilities - To learn the concept of sustainable development and the implication of energy usage					

Unit-I	ENERGY AND ENVIRONMENT	(9)
Primary energy sources-Coal, Oil, Gas-India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP		
Unit-II	ENERGY AUDITING	(9)
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments		
Unit-III	ENERGY EFFICIENCY IN THERMAL UTILITIES	(9)
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories-Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermo compression		
Unit-IV	ENERGY CONSERVATION IN ELECTRICAL UTILITIES	(9)
Demand side management-Power factor improvement-Energy efficient transformers-Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers		
Unit-V	SUSTAINABLE DEVELOPMENT	(9)
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,		
Total No of Periods to be Taught		45 periods

REFERENCES:


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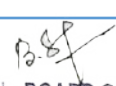


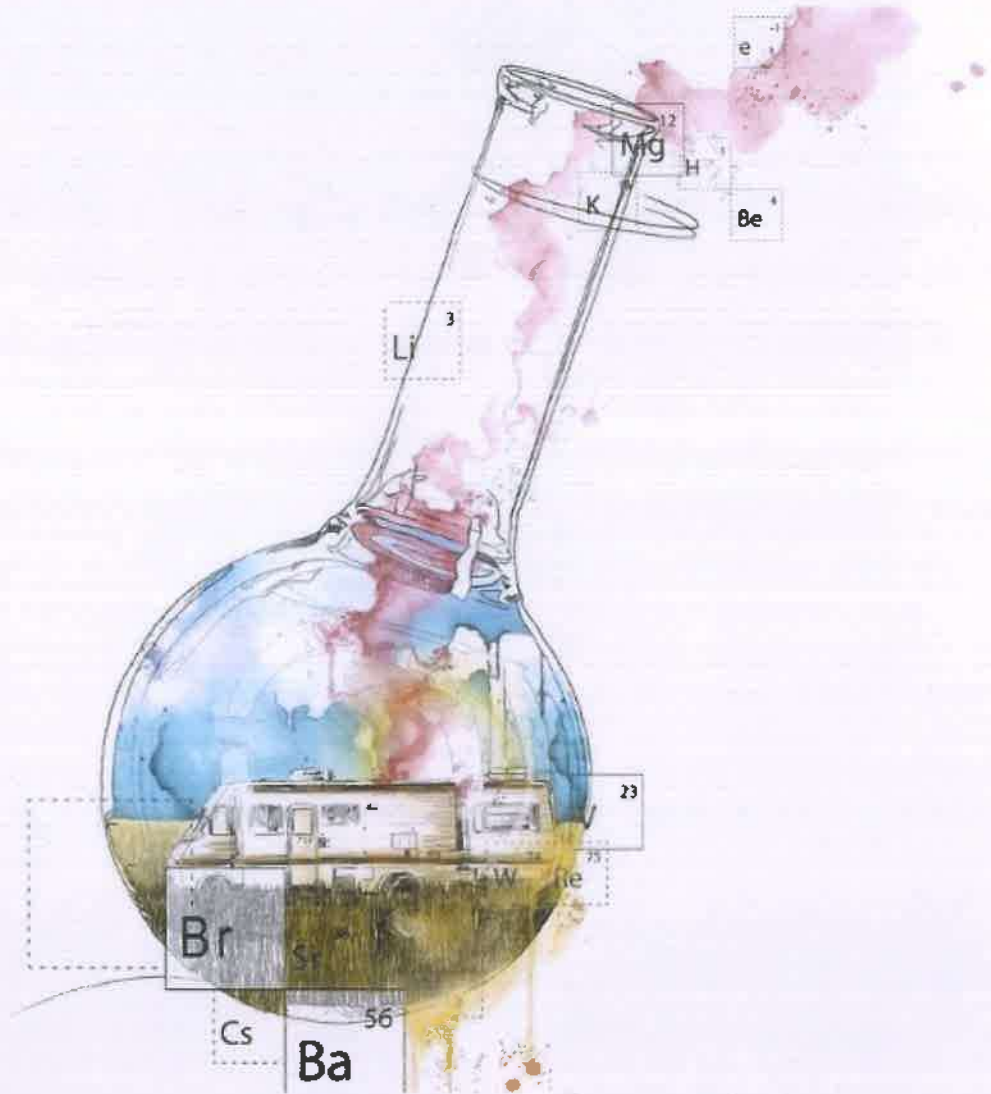
1	Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004
2	Eastop, T.D. & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, ISBN-0-582-03184, 1990
3	W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
4	Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New India Publishing Agency-Nipa, 2020
5	Matthew John Franchetti, Defne Apul "Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies" CRC Press, 2012
6	Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4 th Edition, Wiley, 2022

COURSE OUTCOMES:

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

CO1:	Understand the prevailing energy scenario
CO2:	Familiarise on energy audits and its relevance
CO3:	Apply the concept of energy audit on thermal utilities
CO4:	Employ relevant techniques for energy improvement in electrical utilities
CO5:	Understand Sustainable development and its impact on human resource development


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