



THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

Mecheri, Salem - 636 453.



Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF MECHANICAL 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.*

REGULATIONS - 2024

CHOICE BASED CREDIT SYSTEM

B.E – Mechanical Engineering

VISION

To deliver high quality education that creates new opportunities for students to meet the challenges and in pursuit of excellence in Mechanical Engineering.

MISSION

- To provide a sound mechanical engineering education for a successful career.
- To facilitate team work and culture to improve the social standards of graduates.
- To strengthen the industry institute interaction.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- I. Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and teCsting, smart manufacturing, technical services, and research.
- II. Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.
- III. To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.
- IV. To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.
- V. To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

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 math, science, and engineering fundamentals to complex problems
2.	Problem analysis	Identify and analyze complex problems using research and sustainability principles
3.	Design/development of solutions	Design systems and processes considering health, safety, cost, culture, and environment.
4.	Conduct Investigations of Complex Problems	Use experiments, modelling, and data analysis to reach valid conclusions.
5.	Modern Tool Usage	Apply modern tools for modelling and problem-solving, recognizing their limits
6.	Society & Environment	Assess societal, legal, and environmental impacts of engineering solutions.
7.	Ethics	Commit to ethics, human values, diversity, and legal compliance.
8.	Individual and team work	Work effectively as an individual and in multidisciplinary teams
9.	Communication	Communicate clearly in reports, presentations, and documentation across diverse groups.
10.	Project management and finance	Apply management and economic principles in projects and teamwork.
11.	Life-long learning	Engage in continuous learning, adapt to new technologies, and think critically

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

- Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
- Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.
- Use the engineering analysis and data management tools for effective management of multidisciplinary projects.



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REGULATIONS - 2024

CHOICE BASED CREDIT SYSTEM

B.E – Mechanical Engineering

CURRICULUM & SYLLABI FOR I TO VIII SEMESTERS

(For the students admitted 2024 onwards)

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UENT24101	Professional English -I	3	0	0	3	40	60	100	HSMC
UMAT24102	Matrices and Calculus	3	1	0	4	40	60	100	BSC
UPHT24103	Engineering Physics	3	0	0	3	40	60	100	BSC
UCHT24104	Engineering Chemistry	3	0	0	3	40	60	100	BSC
UPST24105	Problem Solving and Python Programming	3	0	4	3	40	60	100	ESC
UTAT24106	Heritage of Tamils/ தமிழர் மரபு	1	0	0	1	40	60	100	HSMC
Practical / Employability Enhancement									
UIPE24101	Induction Programme								MC
UPSL2413	Problem Solving and Python Programming Laboratory	0	0	4	2	60	40	100	ESC
UPCL2412	Physics and Chemistry Laboratory	0	0	4	2	60	40	100	BSC
UENL2411	English Laboratory	0	0	2	1	60	40	100	EEC
Total Credits to be earned					22				

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UENT24201	Professional English-II	2	0	0	2	40	60	100	HSMC
UMAT24201	Statistics and Numerical Methods	3	1	0	4	40	60	100	BSC
UPHT24205	Material Sciences	3	0	0	3	40	60	100	BSC
UBET24202	Basic Electrical and Electronics Engineering	3	0	0	3	40	60	100	ESC
UGET24201	Engineering Graphics	2	0	4	4	50	50	100	ESC
UTAT24201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1	0	0	1	40	60	100	HSMC
UNCC24001	NSS/YRC/Clubs	2	0	0	0	-	-	-	-
Practical / Employability Enhancement									
UGEL24201	Engineering Practices Laboratory	0	0	4	2	60	40	100	ESC
UBEL24202	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2	60	40	100	ESC
UGEL24202	Communication Laboratory /Foreign Language\$	0	0	4	2	60	40	100	EEC
Total Credits to be earned					23				

\$ - Skill Based Courses

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UMAT24301	Transforms and Partial Differential Equations	3	1	0	4	40	60	100	BSC
UMET24301	Engineering Mechanics	3	0	0	3	40	60	100	ESC
UMET24302	Engineering Metallurgy	3	0	0	3	40	60	100	PCC
Theory with Practical									
UMETL24301	Engineering Thermodynamics	3	0	2	4	50	50	100	PCC
UMETL24302	Manufacturing Processes	3	0	2	4	50	50	100	PCC
UMETL24303	Fluid Mechanics and Machinery	3	0	2	4	50	50	100	PCC
Practical Course (s)									
UMEL24301	Computer Aided Machine Drawing	0	0	4	2	60	40	100	ESC
Mandatory Course									
USD24301	Soft Skill 1	2	0	0	0	100	-	100	MC
Total Credits to be earned					24	CHAIRMAN - BOARD OF STUDIES The Kavery Engineering College.			

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UMET24401	Hydraulics and Pneumatics	3	0	0	3	40	60	100	PCC
UMET24402	Kinematics of Machinery	3	0	0	3	40	60	100	PCC
UESST2401	Environmental Science and sustainability	2	0	0	2	40	60	100	BSC
Theory with Practical									
UMETL24401	Mechanics of Materials	3	0	2	4	50	50	100	PCC
UMETL24402	Manufacturing Technology	2	0	2	3	50	50	100	PCC
UMETL24403	Thermal Engineering	3	0	2	4	50	50	100	PCC
Mandatory Course									
USD24401	Soft Skill 2	2	0	0	0	100	-	100	MC
Total Credits to be earned					19				

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UMET24501	Design of Machine Elements	3	0	0	3	40	60	100	PCC
	Professional Elective I	-	-	-	3	40	60	100	PEC
	Professional Elective II	-	-	-	3	40	60	100	PEC
Theory with Practical									
UMETL24501	Dynamics of Machinery	3	0	2	4	50	50	100	PCC
UMETL24502	Metrology and Measurements	2	0	2	3	50	50	100	PCC
UMETL24503	Heat and Mass Transfer	3	0	2	4	50	50	100	PCC
Employability Enhancement									
UMEL24501	Summer Internship – I *	0	0	0	1	-	100	100	EEC
UIDL24001	Idea Lab	0	0	2	1	-	100	100	EEC
Mandatory Course									
	Mandatory Course - I	2	0	0	0	100	-	100	MC
USD24501	Soft Skill 3	2	0	0	0	100	-	100	MC
Total Credits to be earned					22				

* Two weeks summer internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.

SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UMET24601	Design of Transmission System	3	0	0	3	40	60	100	PCC
	Professional Elective III	-	-	-	3	-	-	-	PEC
	Professional Elective IV	-	-	-	3	-	-	-	PEC
	Open Elective – I	3	0	0	3	40	60	100	OEC
	Open Elective – II	3	0	0	3	40	60	100	OEC
Theory with Practical									
UMETL24601	Finite Element Analysis	3	0	2	4	50	50	100	PCC
Practical									
UMEL24602	Computer Aided Design and Manufacturing	0	0	4	2	60	40	100	PCC
Employability Enhancement									
UMEL24603	Mini Project	0	0	4	2	60	40	100	EEC
Mandatory Course									
USD24601	Soft Skill 4	2	0	0	0	100	-	100	MC
	Mandatory Course II	2	0	0	0	-	-	-	MC
Total Credits to be earned					23				

SEMESTER – VII

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
UGET24706	Industrial Management	3	0	0	3	40	60	100	HSMC
UGET24707	Human Values and Ethics	2	0	0	2	40	60	100	HSMC
	Professional Elective V	3	0	0	3	40	60	100	PEC
	Professional Elective VI	3	0	0	3	40	60	100	PEC
	Open Elective – III	3	0	0	3	40	60	100	OEC
Theory with Practical									
UMETL24701	Mechatronics and IoT	3	0	2	4	50	50	100	PCC
Employability Enhancement									
UMEL24701	Summer Internship – II [#]	0	0	0	1	-	-	100	EEC
Total Credits to be earned					19				

Two weeks summer internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory									
	Open Elective – IV	-	-	-	3	40	60	100	OEC
	Professional Elective VII	-	-	-	3	40	60	100	PEC
Employability Enhancement									
UMEL24801	Project Work / Internship	0	0	20	10	60	40	100	EEC
Total Credits to be earned					16				

PROFESSIONAL ELECTIVES (PE)									
Stream – I Engineering Design									
Course Code	Course Name	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	ESE	Total
UMEPE2401	Design Concepts in Engineering	PE	3	0	0	3	40	60	100
UMEPE2402	CAD/ CAM	PE	3	0	0	3	40	60	100
UMEPE2403	Surface Engineering	PE	3	0	0	3	40	60	100
UMEPE2404	Robotics	PE	3	0	0	3	40	60	100
UMEPE2405	Manufacturing System Design	PE	3	0	0	3	40	60	100
UMEPE2406	Design for Manufacturing	PE	3	0	0	3	40	60	100
UMEPE2407	Design of Material Handling Equipment	PE	3	0	0	3	40	60	100
UMEPE2408	Design of Jigs and Fixtures	PE	3	0	0	3	40	60	100
UMEPE2409	Industrial Layout Design and Safety	PE	3	0	0	3	40	60	100
UMEPE2410	Nano Technology	PE	3	0	0	3	40	60	100
UMEPE2411	New Product Development	PE	3	0	0	3	40	60	100
UMEPE2412	Automotive Materials, Components, Design & Testing	PE	2	0	2	3	50	50	100

Stream – II Energy Engineering									
UMEPE2413	Automotive Systems	PE	3	0	0	3	40	60	100
UMEPE2414	Solar Energy Systems	PE	3	0	0	3	40	60	100
UMEPE2415	Internal Combustion Engines	PE	3	0	0	3	40	60	100
UMEPE2416	Solar vehicle technology	PE	3	0	0	3	40	60	100
UMEPE2417	Renewable Energy Resources	PE	3	0	0	3	40	60	100
UMEPE2418	Refrigeration and Air Conditioning	PE	3	0	0	3	40	60	100
UMEPE2419	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	40	60	100
UMEPE2420	Power Plant Technology	PE	3	0	0	3	40	60	100
UMEPE2421	Energy Conservation & Waste Heat Recovery	PE	3	0	0	3	40	60	100
UMEPE2422	Computational Fluid Dynamics	PE	3	0	0	3	40	60	100
UMEPE2423	Energy Storage Devices	PE	3	0	0	3	40	60	100
UMEPE2424	Energy Conservation in Industries	PE	3	0	0	3	40	60	100
Stream – III Advanced Materials and Manufacturing Systems									
UMEPE2425	Non-Traditional Machining Techniques	PE	3	0	0	3	40	60	100
UMEPE2426	Non-Destructive Testing and Evaluation	PE	2	0	2	3	50	50	100
UMEPE2427	Additive Manufacturing Processes	PE	2	0	2	3	50	50	100
UMEPE2428	Computer Integrated Manufacturing Systems	PE	3	0	0	3	40	60	100
UMEPE2429	Testing of Materials	PE	3	0	0	3	40	60	100
UMEPE2430	Productivity and Reengineering	PE	3	0	0	3	40	60	100
UMEPE2431	Materials Characterization	PE	3	0	0	3	40	60	100
UMEPE2432	Polymer Materials and their Processing	PE	3	0	0	3	40	60	100
UMEPE2433	Mechanical Behaviour of Materials	PE	3	0	0	3	40	60	100
UMEPE2434	Industry 4.0	PE	3	0	0	3	40	60	100
UMEPE2435	Precision Manufacturing	PE	3	0	0	3	40	60	100
UMEPE2436	Material Handling and solid processing Equipment	PE	3	0	0	3	40	60	100

Stream – IV Industrial Engineering									
UMEPE2437	Industrial Engineering	PE	3	0	0	3	40	60	100
UMEPE2438	Product Design and Development	PE	3	0	0	3	40	60	100
UMEPE2439	Process Planning and Cost Estimation	PE	3	0	0	3	40	60	100
UMEPE2440	Lean and Agile Manufacturing	PE	3	0	0	3	40	60	100
UMEPE2441	Industrial Safety and Maintenance Engineering	PE	3	0	0	3	40	60	100
UMEPE2442	Project planning and Management	PE	3	0	0	3	40	60	100
UMEPE2443	Intellectual Property Rights	PE	3	0	0	3	40	60	100
UMEPE2444	Digital Manufacturing and IoT	PE	3	0	0	3	40	60	100
UMEPE2445	Quality Engineering	PE	3	0	0	3	40	60	100
UMEPE2446	Automobile Engineering	PE	3	0	0	3	40	60	100
UMEPE2447	Electric and hybrid vehicles	PE	3	0	0	3	40	60	100
UMEPE2448	Vehicle Health Monitoring Maintenance and Safety	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (For Other Branches)									
Course Code	Course Name	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	ESE	Total
UMEOE2401	Reverse Engineering	OE	2	0	2	3	50	50	100
UMEOE2402	Non - Destructive Testing	OE	2	0	2	3	50	50	100
UMEOE2403	Additive Manufacturing Technology	OE	2	0	2	3	50	50	100
UMEOE2404	Energy Technology	OE	3	0	0	3	40	60	100
UMEOE2405	Renewable Energy Technologies	OE	3	0	0	3	40	60	100
UMEOE2406	Introduction to Industrial Engineering	OE	3	0	0	3	40	60	100
UMEOE2407	Fiber Reinforced Plastics	OE	3	0	0	3	40	60	100
UMEOE2408	NANO Technology and its applications.	OE	3	0	0	3	40	60	100

Mandatory Courses									
Course Code	Course Name	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	ESE	Total
UMC24001	Disaster Risk Reduction and Management	MC	2	0	0	0	100	-	100
UMC24002	Elements of Literature	MC	2	0	0	0	100	-	100
UMC24003	Film Appreciation	MC	2	0	0	0	100	-	100
UMC24004	Introduction to Gender Studies	MC	2	0	0	0	100	-	100
UMC24005	Industrial Safety	MC	2	0	0	0	100	-	100
UMC24006	Interpersonal Skills	MC	2	0	0	0	100	-	100
UMC24007	Personality and Character Development	MC	2	0	0	0	100	-	100
UMC24008	Well Being with Traditional Practices Yoga, Ayurveda and Siddha	MC	2	0	0	0	100	-	100

OPEN ELECTIVES (OEC)

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

List of Open Elective courses offered by Other Engineering Branches for Mechanical Branch

(OPEN ELECTIVES – I, II, III & IV)

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Agricultural Engineering									
UAIOE2401	Introduction to Food processing	3	0	0	3	40	60	100	OEC
UAIOE2402	Traditional Indian Foods	3	0	0	3	40	60	100	OEC
UAIOE2403	Fundamentals of Food Engineering	3	0	0	3	40	60	100	OEC
UAIOE2404	Remote Sensing Concepts	3	0	0	3	40	60	100	OEC
UAIOE2405	Basics of Integrated Water Resources Management	3	0	0	3	40	60	100	OEC
Biomedical Engineering									
UBMOE2401	Basics of Microbial Technology	3	0	0	3	40	60	100	OEC
UBMOE2402	Radiological Equipment	3	0	0	3	40	60	100	OEC
UBMOE2403	Fundamentals of Cell and Molecular Biology	3	0	0	3	40	60	100	OEC
UBMOE2404	Human Physiology	3	0	0	3	40	60	100	OEC
UBMOE2405	Lifestyle Diseases	3	0	0	3	40	60	100	OEC
UBMOE2406	Pathology and Microbiology	3	0	0	3	40	60	100	OEC
UBMOE2407	Medical Electronics	3	0	0	3	40	60	100	OEC
UBMOE2408	Assist Devices	3	0	0	3	40	60	100	OEC
Chemical Engineering									
UCHOE2401	Nanomaterials and applications.	3	0	0	3	40	60	100	OEC
UCHOE2402	Polymer Technology	3	0	0	3	40	60	100	OEC
UCHOE2403	Enzyme engineering	3	0	0	3	40	60	100	OEC
UCHOE2404	Bio Energy Resources	3	0	0	3	40	60	100	OEC
UCHOE2405	Chemical Process Safety	3	0	0	3	40	60	100	OEC
Civil Engineering									
UCEOE2401	Architectural Heritage of India	3	0	0	3	40	60	100	OEC
UCEOE2402	Building Planning and Construction	3	0	0	3	40	60	100	OEC
UCEOE2403	Elementary Civil Engineering	3	0	0	3	40	60	100	OEC
UCEOE2404	Energy and Environment	3	0	0	3	40	60	100	OEC
UCEOE2405	Global Warming and Climate Change	3	0	0	3	40	60	100	OEC
UCEOE2406	Introduction to Disaster Management and Mitigation	3	0	0	3	40	60	100	OEC

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Computer Science and Engineering									
UCSOE2401	Introduction to C Programming	2	0	2	3	50	50	100	OEC
UCSOE2402	Introduction to Data Structures	2	0	2	3	50	50	100	OEC
UCSOE2403	Data Science Fundamentals	2	0	2	3	50	50	100	OEC
UCSOE2404	Introduction of Data Analytics	2	0	2	3	50	50	100	OEC
UCSOE2405	Artificial Intelligence and Machine Learning Fundamentals	2	0	2	3	50	50	100	OEC
UCSOE2406	IoT Concepts and Applications	2	0	2	3	50	50	100	OEC
Electrical and Electronics Engineering									
UEEOE2401	Electrical safety	3	0	0	3	40	60	100	OEC
UEEOE2402	Introduction to Electrical Machines	3	0	0	3	40	60	100	OEC
UEEOE2403	Electric Energy Generation, Utilization and Conservation.	3	0	0	3	40	60	100	OEC
UEEOE2404	Power Electronics and Drives	3	0	0	3	40	60	100	OEC
UEEOE2405	Electrical Estimation and Costing	3	0	0	3	40	60	100	OEC
UEEOE2406	Basics of Electrical Measurements and Instrumentation	3	0	0	3	40	60	100	OEC
UEEOE2407	Introduction to Control Engineering	3	0	0	3	40	60	100	OEC
UEEOE2408	Fundamentals of Electrical Drives and Control	3	0	0	3	40	60	100	OEC
UEEOE2409	Energy Conservation and Management	3	0	0	3	40	60	100	OEC
UEEOE2410	Automotive Electrical and Electronics Engineering	3	0	0	3	40	60	100	OEC
UEEOE2411	Introduction to Embedded Systems	3	0	0	3	40	60	100	OEC
Electronics and Communication Eng									
UECOE2401	Industrial Electronics	3	0	0	3	40	60	100	OEC
UECOE2402	Image Processing and Computer Vision	3	0	0	3	40	60	100	OEC
UECOE2403	4G/5G Communication Networks	3	0	0	3	40	60	100	OEC
UECOE2404	Wireless Communication	3	0	0	3	40	60	100	OEC
UECOE2405	Embedded and Real Time Systems	3	0	0	3	40	60	100	OEC
UECOE2406	Robotics and its Industrial Application	3	0	0	3	40	60	100	OEC
UECOE2407	Industrial IoT	3	0	0	3	40	60	100	OEC
UECOE2408	Sensors and Transducers	3	0	0	3	40	60	100	OEC
UECOE2409	Space Science	3	0	0	3	40	60	100	OEC

SUMMARY

B.E. MECHANICAL ENGINEERING											
S. No	Subject Area	Credits per Semester								Total Credits	Credits in %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	3					5		12	7.05%
2	BSC	12	7	4	2					25	14.71%
3	ESC	5	11	5						21	12.35%
4	PCC			15	17	14	9	4		59	35.90%
5	PEC					6	6	6	3	21	12.35%
6	OEC						6	3	3	12	7.05%
7	EEC	1	2			2	2	1	10	18	10.60%
8	Non-Credit / Mandatory			√	√	√	√				0.00%
Total		22	23	24	19	22	23	19	16	168	100%

HSMC – Humanities, Social Sciences and Management Courses

BSC – Basic Sciences Courses

ESC – Engineering Sciences Course

PCC – Professional Core Courses

PEC – Professional Elective Courses

OEC – Open Elective Courses

EEC – Employment Enhancement Course

MC – Mandatory course

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

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

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

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

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

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

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

VERTICAL 1: FINTECH AND BLOCK CHAIN

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UCMG2401	Financial Management	PEC	3	0	0	3	3
2.	UCMG2402	Fundamentals of Investment	PEC	3	0	0	3	3
3.	UCMG2403	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	UCMG2404	Introduction to Block chain and its applications	PEC	3	0	0	3	3
5.	UCMG2405	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	UCMG2406	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UCMG2407	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	UCMG2408	Team Building & Leadership	PEC	3	0	0	3	3
3.	UCMG2409	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	UCMG2410	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	UCMG2411	Human Resource Management for	PEC	3	0	0	3	3
6.	UCMG2412	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UCMG2413	Principles of Public Administration	PEC	3	0	0	3	3
2.	UCMG2414	Constitution of India	PEC	3	0	0	3	3
3.	UCMG2415	Public Personnel Administration	PEC	3	0	0	3	3
4.	UCMG2416	Administrative Theories	PEC	3	0	0	3	3
5.	UCMG2417	Indian Administrative System	PEC	3	0	0	3	3
6.	UCMG2418	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UCMG2419	Statistics for Management	PEC	3	0	0	3	3
2.	UCMG2420	Data mining for Business Intelligence	PEC	3	0	0	3	3
3.	UCMG2421	Human Resource Analytics	PEC	3	0	0	3	3
4.	UCMG2422	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	UCMG2423	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	UCMG2424	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UCES2425	Sustainable Infrastructure Development	PEC	3	0	0	3	3
2.	UCES2426	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	UCES2427	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	UCES2428	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	UCES2429	Green Technology	PEC	3	0	0	3	3
6.	UCES2430	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	UCES2431	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	UCES2432	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3



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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, DhanpatRai 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 & 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)

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 கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி –வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம் (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.)
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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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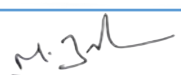


Department	CSE	Programme Code & Name	Common to All
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Semester I

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	English	Programme Code & Name	Common to All
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Semester

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	PSO 2	PSO 3
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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Mecheri, Salem Dt-636453, Tamilnadu



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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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	PHYSICS	Programme Code & Name	114-BE-MECH
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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UPHT24205	MATERIALS SCIENCE	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To make the students to understand the basics of crystallography and its importance in studying materials properties • To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials. • To instil knowledge on physics of semiconductors, determination of charge carriers and device applications. • To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications • To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.					

Unit-I	CRYSTALLOGRAPHY	(9)
Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation		
Unit-II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	(9)
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.		
Unit-III	SEMICONDUCTORS AND TRANSPORT PHYSICS	(9)
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.		
Unit-IV	OPTICAL PROPERTIES OF MATERIALS	(9)
Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics		
Unit-V	NANOELECTRONIC DEVICES	(9)
Quantum confinement – Quantum structures – quantum wells, wires and dots – Zener-Bloch oscillations – Resonant tunneling – quantum interference effects - mesoscopic structures - Single electron phenomena – Single electron Transistor. Semiconductor photonic structures – 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications		

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Total No of Periods to be Taught	45
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TEXT BOOK:

1	R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2	S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018
3	Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007
4	Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5	G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1	REFERENCES: 1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2	Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3	Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4	Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017

COURSE OUTCOMES:

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

CO1:	Know basics of crystallography and its importance for varied materials properties
CO2:	Gain knowledge on the electrical and magnetic properties of materials and their applications
CO3:	Understand clearly of semiconductor physics and functioning of semiconductor devices
CO4:	Understand the optical properties of materials and working principles of various optical devices
CO5:	Appreciate the importance of functional nanoelectronic devices.


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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	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	2	-	-	-	-	-	-	-	-	-	-	-
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	-	-	-	-	-	-	-

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

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	MECHANICAL	Programme Code & Name				114 - Mechanical	
Semester							
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		Programme Code & Name				
Semester						
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)
சங்ககாலத்தில் நெசவுத்தொழில், பாணைத்தொழில்நுட்பம், கருப்பு சிவப்புபாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு 2	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	(3)
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)
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)
அணை, ஏரி, குளங்கள், மதகு சோழர் காலக் குழுழித் 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)
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

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

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	English	Programme Code & Name	
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Semester

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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Department	Mechanical Engineering	Programme Code & Name	105 - Mech
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3rd Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMAT24301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C	100
		3	1	0	4	
Course Objectives	➤ To introduce the basic concepts of PDE for solving standard partial differential equations. ➤ To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems. ➤ To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations. ➤ To acquaint the student with Fourier, transform techniques used in wide variety of situations. ➤ To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.					

Unit-I	PARTIAL DIFFERENTIAL EQUATIONS	(9+3)
Formation of partial differential equations – Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.		
Unit-II	FOURIER SERIES	(9+3)
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.		
Unit-III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	(9+3)
Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation– One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).		
Unit-IV	FOURIER TRANSFORMS	(9+3)
Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions		
Unit-V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	(9+3)
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z- transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
Total No of Periods to be Taught		60 periods

TEXT BOOK:

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

1	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2	Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3	James. G., "Advanced Modern Engineering Mathematics", 4 th Edition, Pearson Education, New Delhi,

COURSE OUTCOMES:

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

CO1:	Understand how to solve the given standard partial differential equations.
CO2:	Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
CO3:	Appreciate the physical significance of Fourier series techniques in solving one-and two-dimensional heat flow problems and one-dimensional wave equations.
CO4:	Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
CO5:	Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time 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	1	0	0	0	2	0	0	3	-	-	3
CO2	3	3	1	1	0	0	0	2	0	0	3	-	-	3
CO3	3	3	1	1	0	0	0	2	0	0	3	-	-	3
CO4	3	3	1	1	0	0	0	2	0	0	3	-	-	3
CO5	3	3	1	1	0	0	0	2	0	0	3	-	-	3
Avg.	3	3	1	1	0	0	0	2	0	0	3	-	-	3

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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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24301	ENGINEERING MECHANICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures. - To analyze the behaviour of the rigid body under the action of forces - To study and understand the distributed forces, surface, loading on beam and intensity. - To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems. - To develop basic dynamics concepts – force, momentum, work and energy.					

Unit-I	STATICS OF PARTICLES	(9)
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space		
Unit-II	EQUILIBRIUM OF RIGID BODIES	(9)
Statics of rigid body in two dimensions - rigid body - moment of a force about a point - varignon's theorem - resultant force for coplanar parallel and non-concurrent forces - moments and couples - equilibrium of rigid bodies in two dimensions - requirements of stable equilibrium - types of supports and their reactions.		
Unit-III	DISTRIBUTED FORCES	(9)
Centroid – centre of gravity- Theorems of Pappus and Guldinus – moment of inertia of plane areas - transfer theorems - parallel axis and perpendicular axis theorem- radius of gyration- product of inertia polar moment of inertia – principal axes and principal moment of inertia of plane areas.		
Unit-IV	FRICTION	(9)
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.		
Unit-V	DYNAMICS OF PARTICLES	(9)
Kinematics - Displacements, velocity and acceleration, their relationship -rectilinear motion – curvilinear motion - projectile motion. Kinetics - Newton's law – D'Alembert's principle - impact of elastic bodies.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.
2	Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1	Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2	Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3	Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.

COURSE OUTCOMES:

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

CO1:	Illustrate the vector and scalar representation of forces and moments
CO2:	Analyse the rigid body in equilibrium
CO3:	Analyse the properties of distributed forces
CO4:	Determine the friction and the effects by the laws of friction
CO5:	Calculate dynamic forces exerted in rigid body

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	-	-	-	-	-	-	2	3	1	1
CO2	3	2	2	1	-	-	-	-	-	-	2	3	1	1
CO3	3	2	3	1	-	-	-	-	-	-	2	3	1	2
CO4	3	2	3	1	-	-	-	-	-	-	2	3	1	2
CO5	3	2	3	1	-	-	-	-	-	-	2	3	1	2
Avg.	3	2	2.6	1	-	-	-	-	-	-	2	3	1	1.6

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


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Mecheri, Salem Dt-636453, Tamilnadu



Department	Mechanical	Programme Code & Name	114-Mechanical
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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24301	ENGINEERING THERMODYNAMICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart knowledge on various forms of energy, energy transfer and energy interactions.					
	Impart knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.					
	Impart knowledge on availability and applications of second law of thermodynamics.					
	Teach the various properties of steam through steam tables and Mollier chart.					
	Impart knowledge on the macroscopic properties of ideal and real gases.					

Unit-I	FIRST LAW OF THERMODYNAMICS	(9)
Thermodynamic systems, Properties and processes Thermodynamic Equilibrium -Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.		
Unit-II	SECOND LAW AND CONCEPT OF ENTROPY	(9)
Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance, Principle of increase in entropy.		
Unit-III	EXERGY ANALYSIS	(9)
High- and low-grade energy, Exergy and Anergy, Availability and Irreversibility for open and closed system processes - Ist and IInd law Efficiency, Applications of IInd Law.		
Unit-IV	PROPERTIES OF PURE SUBSTANCES, Ideal AND REAL GASES	(9)
Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction of wet and very wet steam. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Properties of Ideal gas, real gas - comparison. Equations of state for ideal gas. Real Gas, Vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart.		
Unit-V	GAS MIXTURES AND THERMODYNAMIC RELATIONS	(9)
Gas mixtures, Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius- Clapeyron equation		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Nag.P.K., "Engineering Thermodynamics", 6 th Edition, Tata McGraw Hill (2017), New Delhi
2	Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill, 8th Edition, 2015


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REFERENCES:

1	Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
2	E. Natarajan, Engineering Thermodynamics-Fundamentals and Applications, First Edition 2019, ISBN: 93-1568-61-3, Anuragam Publication
3	Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016
4	Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 7th Edition, Wiley Eastern, 2009.
5	Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

Note: Steam Tables with Mollier Chart and Compressibility Chart shall be supplied during Examination.

List of Exercises/Experiments

1. Determination of Temperature Using Thermometer Based on Zeroth Law of Thermodynamics	
2. Verification of First Law using a air compressor unit.	
3. To determine power requirement of to drive the blower.	
4. Determination of COP of a Vapour Compression Refrigeration System.	
5. Study of Heat Pump and Heat Engine.	
6. Energy Loss Evaluation in a Heat Exchanger.	
7. Determination of Availability (Energy) in a 4-Stroke Diesel Engine.	
8. Measurement of Condenser Efficiency Using Vertical and Horizontal Surface Condensers.	
9. Study and Understanding of Thermal Power Generation Cycle at Mettur Thermal Power Station.	
10. Measure the Joule-Thomson coefficient (μ) and observe cooling/heating during throttling.	
Total No of Periods to be Taught	30

COURSE OUTCOMES:

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

CO1:	Explain the thermodynamic properties and solve the problems related to closed and open systems.
CO2:	Select the second law of thermodynamics and entropy principle to various thermodynamic systems.
CO3:	Use the various thermodynamic relations to available and unavailable energy.
CO4:	Calculate the properties of steam using PV diagrams, H-S diagrams and steam power cycle.
CO5:	Explain the thermodynamic relations and compute properties of gas mixtures


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Multi-Stage Reciprocating Air Compressor	01 No.
2.	Vapour Compression Refrigeration System	01 No.
3.	Parallel Flow/Counter Flow Heat Exchanger	01 No.
4.	Four Stroke Single Cylinder Diesel Engine with Mechanical Load	01 No.
5.	Vertical and Horizontal Surface Condenser	01 No.
6.	Open Cup Apparatus for Flash and Fire point	01 No.
7.	Air Blower	01 No.
8.	Tachometer	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	3	2	1	-	1	-	-	-	-	1	2	1	2
CO2	2	3	2	1	-	1	-	-	-	-	1	3	1	2
CO3	2	3	2	1	1	1	-	-	-	-	1	3	2	2
CO4	2	3	2	1	-	1	-	-	-	-	1	2	2	2
CO5	2	3	2	1	-	1	-	-	-	-	1	2	1	2
Avg.	2	3	2	1	0.2	1	-	-	-	-	1	2.4	1.4	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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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24302	Manufacturing Processes	L	T	P	C	100
		3	0	2	4	
Course Objectives	- Learn various aspects of different manufacturing techniques such as various casting methods and Techniques. - Have a broad knowledge on welding methods for making various joints. - Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes. - Acquire knowledge about the various tools, equipment, machinery and operations required for these metal forming processes. - Introduce the basic concepts of plastic components manufacturing processes.					

Unit-I	CASTING PROCESSES	(9)
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties. Principles of special casting processes; shell moulding, investment casting, pressure die casting, centrifugal casting, CO2 process.		
Unit-II	METAL JOINING PROCESSES	(9)
Gas tungsten arc welding, gas metal arc welding, submerged arc welding, resistance welding, plasma arc welding, thermit welding, friction stir welding, brazing and soldering, welding defects, causes and remedies.		
Unit-III	METAL FORMING PROCESSES	(9)
Forging: Classification of forging processes – forging defects and inspection. Rolling - Hot and cold rolling, process parameters, drawing and extrusion.		
Unit-IV	SHEET METAL PROCESSES	(9)
Sheet metal forming methods - Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning. High Velocity Forming, Explosive forming, Electro hydraulic forming - magnetic pulse forming, pneumatic and mechanical high velocity forming.		
Unit-V	MANUFACTURE OF PLASTIC COMPONENTS	(9)
Processing of ceramics - shaping, drying and firing - finishing operations - Glass - fabrication, classification, uses and design considerations - composite materials - particle reinforced and fiber reinforced composites - design considerations.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Kalp akjian. S, “Manufacturing Engineering and Technology”, Pearson Education India, 4th Edition, 2013
2	P.N .Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition, 2018.


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REFERENCES:

1	Ro y. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2	S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3	Pa ul Degarma E, Black J.T and Ronald A. Kosher, Elighth Edition, Materials and Processes, in anufacturing, Eight Edition, Prentice – Hall of India, 1997.
4	Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2014.

List of Exercises/Experiments

1.Preparation of greensand mould for solid pattern	
2.Preparation of greensand mould for split pattern	
3.Preparation of Greensand mould For Gear Pattern	
4.Joining of T shaped plates using Metal Arc Welding	
5.Joining of plates using butt Welding	
6.Joining of Metals by Soldering Process	
7.Cold forming of Round into Square	
8.Preparation of tray using sheet metal	
9.Preparation of funnel using sheet metal	
10.To study Hot and cold rolling (Field visit arranged for the students).	
Total No of Periods to be Taught	30

COURSE OUTCOMES:

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

CO1:	Explain different metal casting processes, associated defects, merits and demerits.
CO2:	Compare different metal joining processes
CO3:	Summarize various hot working and cold working methods of metals.
CO4:	Explain various sheet metal making processes.
CO5:	Distinguish various methods of manufacturing plastic components.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Anvil	1 No.
2.	Arc Welding Machine	3 Nos.
3.	Ball pean hammer	3 Nos.
4.	Bend snips	3 Nos.
5.	Centre punches	3 Nos.
6.	Divider	3 Nos.
7.	Furnace	1 No.
8.	Pliers	3 Nos.
9.	Prick Punches	3 Nos.
10.	Raising hammer	3 Nos.
11.	Riveting hammer	3 Nos.
12.	Scriber	3 Nos.
13.	Soldering Machine	2 Nos.
14.	Steel rule	3 Nos.
15.	Straight snips	3 Nos.
16.	Swage block	1 No.
17.	Trammel	3 Nos.

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	-	2	3	1	1	-	-	1	3	1
CO2	3	-	2	1	-	2	3	1	1	-	-	1	3	1
CO3	3	-	2	1	-	2	2	1	1	-	-	1	3	1
CO4	3	-	2	1	-	2	2	1	1	-	-	1	3	1
CO5	3	-	2	1	-	2	2	1	1	-	-	1	3	1
Avg.	3	-	2	1	-	2	2.4	1	1	-	-	1	3	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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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24302	ENGINEERING METALLURGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for Microstructure formation - To learn selecting and applying various heat treatment processes and its microstructure formation. - To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field. - To illustrate the different polymer, ceramics and composites and their uses in engineering field. - To learn the various testing procedures and failure mechanism in engineering field.					

Unit-I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	(9)
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.		
Unit-II	HEAT TREATMENT	(9)
Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.		
Unit-III	FERROUS AND NON-FERROUS METALS	(9)
Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V, Ti & W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications.		
Unit-IV	NON-METALLIC MATERIALS	(9)
Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers –Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al ₂ O ₃ , SiC, Si ₃ N ₄ , PSZ and SIALON - Composites- Matrix and reinforcement Materials- applications of Composites.		
Unit-V	DYNAMICS OF PARTICLES	(9)
Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and Charpy, fatigue and creep failure mechanisms.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9th edition ,2018.
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REFERENCES:

1	A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006
2	Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3	G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt.Ltd, New Delhi, 2020.
4	Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt.Ltd. 6th edition, 2019.
5	Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, 2nd edition Re print 2019.

COURSE OUTCOMES:

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

CO1:	Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
CO2:	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3:	Clarify the effect of alloying elements on ferrous and non-ferrous metals.
CO4:	Summarize the properties and applications of non-metallic materials.
CO5:	Explain the testing of mechanical properties

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	1	2
CO2	2	1	1	1	-	-	-	-	-	-	2	2	1	2
CO3	2	1	1	1	-	-	-	-	-	-	2	2	1	2
CO4	2	1	1	1	-	-	-	-	-	-	2	2	1	2
CO5	2	1	1	1	-	-	-	-	-	-	2	2	1	2
Avg.	2	1	1	1	-	-	-	-	-	-	2	2	1	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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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24303	FLUID MECHANICS AND MACHINERY	L	T	P	C	100
		3	0	2	4	
Course Objectives	- To introduce the basic principles and properties of fluids. - To analyze fluid flow using fundamental equations. - To evaluate losses in pipelines and understand boundary layer concepts. - To apply dimensional analysis and model studies for real-world applications. - To understand the working and design of turbines and pumps. - To verify fluid and machinery concepts through laboratory experiments.					

Unit-I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	(9)
Definitions of fluid-Properties of fluids-Fluid pressure and its measurements-- Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian Principle of fluid flow- concept of control volume and system - Continuity equation, energy equation and momentum equation -Applications.		
Unit-II	FLOW THROUGH PIPES AND BOUNDARY LAYER	(9)
Reynold's Experiment-Laminar flow through circular conduits -Darcy Weisbach equation - friction factor- Moody diagram- minor losses- Hydraulic gradient and total energy gradient-Pipes in series and parallel-Boundary layer concepts-types of boundary layer thickness.		
Unit-III	DIMENSIONAL ANALYSIS AND MODEL STUDIES	(9)
Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		
Unit-IV	TURBINES	(9)
Impact of jets - Velocity triangles - Theory of roto-dynamic machines - Classification of turbines - Pelton wheel, Francis turbine and Kaplan turbine- Working principles - Work done by water on the runner - Efficiencies - Draft tube - Specific speed - Performance curves for turbines. Field visit arranged for the students to gain knowledge about turbines.		
Unit-V	PUMPS	(9)
Classification of pumps- Centrifugal pumps - Working principle - Heads and efficiencies-Work done by the impeller - Pumps connected in series and parallel - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations - Air vessels - Work saved by air vessels.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Modi P.N. and Seth S. M., Hydraulics and Fluid Mechanics including Hydraulics Machines, 22nd Ed., Standard Book House. New Delhi, 2019.
2	Jain A.K .Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.


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REFERENCES:

1	Kumar K. L, Engineering Fluid Mechanics, (8thEd.) S. Chand Publishing(India) Pvt .Ltd., New Delhi, 2016.
2	Some S.K. Gautam Biswas and Chakraborty's, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2017.
3	Subramanya, K. Fluid Mechanics and Hydraulic Machines, 2ndEd. Tata McGraw- Hill Pub. Co., New Delhi, 2018
4	YunusA. Cengel; John M. Cimbala, Fluid Mechanics, 4thEd. McGrawHillEducationPvt. Ltd.,2019.
5	Streeter,V.L.andWylieE.B.,FluidMechanics,McGrawHillPublishingCo.,1998

List of Exercises/Experiments

1. Determination of the Coefficient of discharge of Venturi meter	
2.Determination of the Coefficient of discharge of given Orifice meter	
3. Determination of friction factor for flow through pipes	
4. Characteristics of Pelton wheel turbine	
5. Characteristics of centrifugal pumps	
6. Characteristics of reciprocating pump	
7.Characteristics of gear oil pump	
8. Calculation of the rate of flow using Rota meter.	
9.Determination of metacentric height	
10.Dertermination forces due to impact of jet on fixed plate	
Total No of Periods to be Taught	30

COURSE OUTCOMES:

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

CO1:	Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.
CO2:	Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
CO3:	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
CO4:	Explain the working principles of various turbines and design the various types of turbines.
CO5:	Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Venturi meter setup	01 No.
2.	Friction Apparatus setup	01 No.
3.	Metacentric Height apparatus setup	01 No.
4.	Impact of jet setup	01 No.
5.	Centrifugal pump set up	01 No.
6.	Reciprocation pump set up	01 No.
7.	Pelton Wheel turbine set up	01 No.
8.	Stop watch	15 Nos.
9.	Tachometer	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	1	1	1	2	1	1	1	3	2	2
CO2	3	3	3	1	1	1	1	2	1	1	1	3	3	3
CO3	3	3	3	2	1	1	1	2	1	1	1	3	3	3
CO4	3	3	3	2	1	1	1	3	1	1	1	3	3	3
CO5	3	3	3	2	1	1	1	3	1	1	1	3	3	3
Avg.	3	2.8	2.6	1.6	1	1	1	2	1	1	1	3	2.8	2.8
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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Third Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEL24301	COMPUTER AIDED MACHINE DRAWING	L	T	P	C	100
		0	0	4	2	
Course Objectives	- To acquaint the skills and practical experience in handling 2D drafting and 3D modeling software systems, standard drawing practices using fits and tolerances. - To prepare assembly drawings using standard CAD packages. - To Preparing standard drawing layout for modeled parts, assemblies with BoM.					

List of Exercises/Experiments	
PART I DRAWING STANDARDS & FITS AND TOLERANCES	(12)
1. CAD Introduction	
Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners. Limits, Fits – Tolerancing of individual dimensions - basic principles of Geometric Dimensioning & Tolerancing.	
PART II CREATION OF 3D ASSEMBLY MODEL AND DETAILING OF FOLLOWING MACHINE ELEMENTS USING 3D MODELLING SOFTWARE	(48)
1. Couplings – Flange, Oldham's, Muff couplings.	
2. Joints – Universal, Knuckle joints.	
3. Machine Components – Screw Jack, Machine Vice, Plummer Block	
Total No of Periods to be Taught	60

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Prepare standard drawing layout for modelled assemblies with BoM.
CO2:	Model orthogonal views of machine components.
CO3:	Prepare standard drawing layout for modelled parts

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Intel Core i5 processor with 16GB Ram, 500GB HDD	30 Nos.
2.	Modeling Software	30 License.


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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	2	-	-	3	-	-	-	3	2	-	2	2	2
CO2	1	2	-	-	3	-	-	-	3	2	-	2	2	2
CO3	1	2	-	-	3	-	-	-	3	2	-	2	2	2
Avg.	1	2	-	-	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				114 - Mechanical	
Semester							
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/arithmatic-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

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24401	HYDRAULICS AND PNEUMATICSS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To provide the knowledge on the working principles of fluid power systems. - To study the fluids and components used in modern industrial fluid power system. - To develop the design, construction and operation of fluid power circuits. - To learn the working principles of pneumatic power system and its components. - To provide the knowledge of trouble shooting methods in fluid power systems					

Unit-I	FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS	(9)
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space		
Unit-II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	(9)
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators- Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems		
Unit-III	HYDRAULIC CIRCUITS AND SYSTEMS	(9)
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.		
Unit-IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	(9)
Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits		
Unit-V	TROUBLE SHOOTING AND APPLICATIONS	(9)
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.		
Total No of Periods to be Taught		45

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TEXT BOOK:

1	Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2	James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997

REFERENCES:

1	Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
2	Joshi.P., Pneumatic Control”, Wiley India, 2008.
3	Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, TataMcGraw Hill, 2001
4	Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006
5	Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition, 2019.

COURSE OUTCOMES:

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

CO1:	Apply the working principles of fluid power systems and hydraulic pumps.
CO2:	Apply the working principles of hydraulic actuators and control components.
CO3:	Apply the concepts to Design and develop hydraulic circuits and systems.
CO4:	Apply the working principles of pneumatic circuits and power system and its components.
CO5:	Identify various troubles shooting methods in fluid power 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	1	-	-	-	-	-	-	2	3	1	1
CO2	3	2	2	1	-	-	-	-	-	-	2	3	1	1
CO3	3	2	3	1	-	-	-	-	-	-	2	3	1	2
CO4	3	2	3	1	-	-	-	-	-	-	2	3	1	2
CO5	3	2	3	1	-	-	-	-	-	-	2	3	1	2
Avg.	3	2	2.6	1	-	-	-	-	-	-	2	3	1	1.6

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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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24402	KINEMATICS OF MACHINERY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the basic components and layout of linkages in the assembly of a system machine - Understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism. - Understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions. - Understand the basic concepts of toothed gearing and kinematics of gear trains. - Understand the role of friction in drives and brakes.					

Unit-I	BASICS OF MECHANISMS	(9)
Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Mechanical advantage – Transmission Angle.		
Unit-II	KINEMATICS OF LINKAGE MECHANISMS	(9)
Displacement, velocity, and acceleration analysis of Four bar and Slider crank mechanisms with turning and sliding pairs – Graphical method & Analytical method		
Unit-III	KINEMATICS OF CAMS	(9)
Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, simple harmonic, constant acceleration and deceleration, and cycloidal motions – Circular arc and tangent cams – sizing of cams.		
Unit-IV	GEARS AND GEAR TRAINS	(9)
Law of toothed gearing – Involute and cycloidal tooth profiles – Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.		
Unit-V	FRICTION IN MACHINE ELEMENTS	(9)
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Belt and rope drives – Friction in brakes.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Khurmi.R.S and Gupta.J.K, “Theory of Machines”, 14th ed., S.Chand and Company Pvt. Ltd., 2015
2	Rattan, S.S, “Theory of Machines”, 4th Edition, Tata McGraw-Hill, 2014.
3	Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014.

REFERENCES:

1	Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961
2	Bansal.R.K and Brar.J.S, “Theory of Machines”, 5th ed., Laxmi Publications, Revised 2016
3	Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, 3rd Edition Affiliated
4	East-West Pvt. Ltd., New Delhi, 2006.
5	John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.

COURSE OUTCOMES:

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

CO1:	Analyze the concepts of mechanisms, machines and their motions.
CO2:	Evaluate the displacement, velocity, and acceleration of simple mechanism.
CO3:	Construct different cam profiles for given conditions using graphical & theoretical methods.
CO4:	Estimate basic terminologies of gears and gear trains and Evaluate.
CO5:	Choose friction drives in various mechanical components under different Situations.

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	-	2	-	-	-	-	-	-	-	1	2
CO2	2	3	2	-	2	-	-	-	-	-	-	-	1	2
CO3	2	3	2	-	2	-	-	-	-	-	-	-	1	2
CO4	2	3	2	-	2	-	-	-	-	-	-	-	1	2
CO5	2	3	2	-	2	-	-	-	-	-	-	-	1	2
Avg.	2	3	2	-	2	-	-	-	-	-	-	-	1	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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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24401	MECHANICS OF MATERIALS	L	T	P	C	100
		3	0	2	4	
Course Objectives	- To develop the understanding of the principle concepts of stress, strain and deformation of solids for various engineering applications. - To analyse the flexural and shear stresses induced in beams due to different loading conditions - To analyze the effect of torsion on shafts and springs. - To understand and analyze the deflection of beams for different support and loading conditions - To examine the stresses induced in thin and thick shells.					

Unit-I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	(9)
Rigid bodies and deformable solids –Stresses and strains: Tension, Compression and Shear - Elastic constants – Relationships – Compound bars – Thermal stresses –Volumetric strains – Stress on inclined planes – Principal stresses and principal planes.		
Unit-II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM	(9)
Beams – Types - Transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams - Theory of simple bending – Bending stress distribution - Load carrying capacity - Proportioning of sections.		
Unit-III	TORSION	(9)
Theory of Pure Torsion- Stresses and deformation in circular and hollows shafts – Transmission of power through hollow & solid shafts – Stepped shafts –Shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs.		
Unit-IV	DEFLECTION OF BEAMS	(9)
Double Integration method – Macaulay's method – Area moment method - Conjugate beam method - Strain energy method - computation of slopes and deflections in beams- Maxwell's reciprocal theorem.		
Unit-V	THIN & THICK SHELLS, THEORIES OF FAILURE	(9)
Stresses and deformations in thin cylindrical shells and spherical shells subjected to internal pressure – Stresses in thick cylinders – Lamé's theory – Application of theories of failure.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2018
2	Rajput, R.K., Strength of Materials, S Chand And Company Ltd., New Delhi, 2018


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REFERENCES:

1	Strength of Materials Laboratory Manual, Anna University, Chennai - 60002
2	IS 432 (art I) -1992, Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
3	Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2015.
4	Ferdinand P. Beer, Russell Johnson, Jr. and John J. Dewole Mechanics of Materials, 7 th Edition, Tata McGraw Hill publishing 'co. Ltd., New Delhi, 2014.
5	Hibbeler, R.C., Mechanics of Materials, Pearson Education, 10th Edition, 2022.

List of Exercises/Experiments

1.	Tension test on mild steel rod	
2.	Deflection test on beams.	
3.	Brinell hardness test.	
4.	Impact test on Izod test	
5.	Hardening test using muffle furnace	
6.	Double shear test on metal.	
7.	Impact test on Charpy test.	
8.	Torsion test on mild steel rod.	
9.	Compression test on helical spring.	
10.	Rockwell hardness test.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Have thorough understanding of the fundamental concepts of stress and strains and understand the mechanical behaviour of materials such as tension, compression and hardness.
CO2:	Understand the bending and shear stress distribution in beams.
CO3:	Have sufficient knowledge on designing shaft to transfer power and understand the behaviour of helical spring
CO4:	Have the ability to determine the deflection of beams and carriage springs
CO5:	Have the knowledge of behaviour of cylindrical and spherical shells.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Brinell Hardness Testing Machine	1 No.
2.	Compression Testing on Spring	1 No.
3.	Impact Testing Machine	1 No.
4.	Muffle Furnace	1 No.
5.	Rockwell Hardness Testing Machine	1 No.
6.	Torsion Testing Machine	1 No.
7.	Universal Testing Machine	1 No.
8.	Beam Deflection Apparatus	1 No.
9.	Dial Gauge	5 Nos.
10.	Extensometer	1 No.
11.	Vernier Calliper	2 Nos.
12.	Brinell Hardness Testing Machine	1 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	3	2	3	2	2	3	3	1	1	2	3	3	2
CO2	3	3	3	3	2	3	3	1	1	1	2	3	2	2
CO3	3	3	3	3	2	3	3	3	1	1	2	3	3	2
CO4	3	3	3	3	2	2	2	3	1	1	2	3	2	2
CO5	3	3	3	3	2	3	3	1	1	1	2	3	3	2
Avg.	3	3	3	3	2	3	3	3	1	1	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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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24402	MANUFACTURING TECHNOLOGY	L	T	P	C	100
		3	0	2	3	
Course Objectives	- To study the concepts and basic mechanics of metal cutting and the factors affecting machinability - To learn working of basic and advanced turning machines. - To apply the working of machine namely shaping, planning, slotting and different drilling machines. - To study the basic concepts of CNC of machine tools and constructional features of CNC - To learn the basics of CNC programming concepts to develop the part Programme for Machine Centre and turning Centre.					

Unit-I	THEORY OF METAL CUTTING	(9)
Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.		
Unit-II	TURNING MACHINES	(9)
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle– multi spindle.		
Unit-III	RECIPROCATING MACHINE TOOLS	(9)
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation- Gear cutting, gear hobbing and gear shaping – gear finishing methods types of grinding process – cylindrical grinding, surface grinding, centerless grinding, internal grinding.		
Unit-IV	CNC MACHINES	(9)
Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous- Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features. Industrial visit arranged for the benefit of the student		
Unit-V	PROGRAMMING OF CNC MACHINE TOOLS	(9)
Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centres and Turning centres – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.		
Total No of Periods to be Taught		45

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1	Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 4th Edition, 2013
2	P.N .Rao Manufacturing Technology Volume 1 McGrawhill Education 5th edition, 2018.

REFERENCES:

1	HajraChoudhury S.K, HajraChoundhury A.K and Nirjhar Roy, "Elements of Workshop Technology", Vol. 1, 2017
2	HMT, "Production Technology", "McGraw Hill Education", 2017
3	Sharma.P.C, "A Textbook of Production Technology", S. Chand Publications, 2014
4	S. Gowri P. Hariharan, A.SureshBabu, Manufacturing Technology I, Pearson Education, 2008.
5	Ro y. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.

List of Exercises/Experiments

1.	Plain turning, Step turning operations.	
2.	Taper turning, operation.	
3.	Measurement of cutting forces in turning using dynamometer.	
4.	Drilling and reaming of a hole using a radial drilling machine.	
5.	Measurement of cutting forces in milling machine using dynamometer.	
6.	Cutting of spur gear using a milling machine.	
7.	Plain Surface grinding.	
8.	Cylindrical grinding.	
9.	Gear generation in hobbing.	
10.	Shaping-square heads on square parts using shaping machine.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
CO2:	To learn working of basic and advanced turning machines
CO3:	To apply the working of machine namely shaping, planning, slotting and different drilling machines
CO4:	To study the basic concepts of CNC of machine tools and constructional features of CNC
CO5:	To learn the basics of CNC programming concepts to develop part programmes.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Centre Lathe	5 Nos.
2.	Cylindrical Grinding Machine	1 No.
3.	Gear Hobbing Machine	1 No.
4.	Horizontal Milling Machine	1 No.
5.	Radial Drilling Machine	1 No.
6.	Shaping Machine	1 No.
7.	Surface Grinding Machine	1 No.
8.	Vertical Milling Machine	1 No.
9.	Arc welding transformer with cables and holders	2 Nos.
10.	Lathe Tool Dynamometer	1 No.
11.	Milling Tool Dynamometer	1 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	0	-	-	-	-	-	2	-	-	3	-	-
CO2	3	2	2	-	-	-	-	-	1	2	-	2	1	-
CO3	2	3	2	-	-	-	-	-	1	-	-	2	2	-
CO4	2	1	2	-	-	2	-	-	1	-	-	2	1	1
CO5	2	2	3	1	3	0	1	3	2	1	2	3	3	2
Avg.	2.4	2	1.8	0.2	0.6	0.4	0.2	0.6	1.4	0.6	0.4	2.4	1.4	0.6
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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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24403	THERMAL ENGINEERING	L	T	P	C	100
		3	0	2	4	
Course Objectives	- Applying the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles. - Understanding working of steam power cycle and analysing its performance improvements. - Understanding the working of IC engines and determining its performance - Assessing the performance of an air compressor. - Comprehending the working principle of various refrigeration systems					

Unit-I	THERMODYNAMIC CYCLES	(9)
Air Standard Cycles – Carnot, Otto, Diesel, Dual – Cycle Analysis, Comparison of Otto, Diesel and Dual Cycle, Atkinson, Stirling, Ericsson, Lenoir cycles.		
Unit-II	VAPOUR POWER CYCLE	(9)
Carnot Cycle, Basic Rankine Cycle, Comparison, Rankine cycle Improvements- Reheat, Regenerative Cycle, Kalina Cycle, Concept of Cogeneration, Combined cycle power generation		
Unit-III	INTERNAL COMBUSTION ENGINES	(9)
IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, P-V diagrams- two stroke & four stroke, and SI & CI engines – comparison. Fuels - Types and Characteristics - Determination of Properties of Fuels –Combustion in SI & CI Engines – Abnormal combustion- Knocking and detonation. Measurement of Performance parameters, Performance calculations.		
Unit-IV	AIR COMPRESSORS	(9)
Classification and comparison, working principle, work of compressor - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor, Intercooling and after cooling, Rotary compressors, working principle and types, comparison		
Unit-V	REFRIGERATION SYSTEM	(9)
Types, Bell-Coleman cycle, Air refrigeration, Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Refrigerant types and properties, ODP and GWP, Performance calculations, vapour absorption system, and Thermoelectric refrigeration.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2	Ganesan.V , " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.
3	Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
4	Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011
5	Arora, " Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2010.

REFERENCES:

1	Nag P.K, " Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2010
2	Domkundwar, Kothandaraman, & Domkundwar, " A Course in Thermal Engineering", 6th Edition, Dhanpat Rai& Sons, 2011.
3	Ananthanarayanan P.N, " Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013
4	Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
5	Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.

List of Exercises/Experiments

1.	Valve timing diagram.	
2.	Port timing diagram.	
3.	Performance test on Diesel engine with mechanical load.	
4.	Determination of frictional power for single cylinder diesel engine.	
5.	Performance test on petrol engine with electrical load.	
6.	Determination the viscosity of given fuels.	
7.	Determination of flash and fire point of given fuel.	
8.	Determination of cloud and pour point of given fuel.	
9.	Performance evaluation of reciprocating multi-stage compressor.	
10.	Determination of COP of a given vapour compression refrigeration system.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Choose an appropriate gas power cycle and operate with optimum efficiency
CO2:	Evaluate performance of different vapour power cycles
CO3:	Test, measure, and analyse IC engine performance
CO4:	Assess the performance of air compressors under different operating conditions
CO5:	Assess the performance of refrigeration systems and estimate their COP.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Four Stroke Single Cylinder Diesel Engine with Mechanical Load	01 No.
2.	Four Stroke Single Cylinder Petrol Engine with Electrical Load	01 No.
3.	Multi-Stage Reciprocating Air Compressor	01 No.
4.	Vapour Compression Refrigeration System	01 No.
5.	Apparatus for Flash and Fire point	01 No.
6.	Apparatus for Cloud and Pour point	01 No.
7.	4 Stroke Single Cylinder Diesel Engine with Cut Section Model	01 No.
8.	2 Stroke Single Cylinder Petrol Engine with Cut Section Model	01 No.
9.	Redwood Viscometer	01 No.
10.	Tachometer	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	2	2	2	-	-	-	-	-	1	2	2	1
CO2	3	2	2	2	2	-	-	-	-	-	1	2	2	1
CO3	3	2	2	2	2	-	-	-	-	-	1	2	2	1
CO4	3	2	2	2	2	-	-	-	-	-	1	2	2	1
CO5	3	2	2	2	2	-	-	-	-	-	1	2	2	1
Avg.	3	2	2	2	2	-	-	-	-	-	1	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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Fourth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UESST2401	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 nonrenewable 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.		
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- Socio-economical and technological change		
Total No of Periods to be Taught		30


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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.

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 Black swan Pvt. Ltd. 2013.

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.

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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	2	1	-	-	-	2	3	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	3	-	-	-	2	-	-	-
CO3	3	-	1	-	-	2	2	-	-	-	2	-	-	-
CO4	3	2	1	1	-	2	2	-	-	-	2	-	-	-
CO5	3	2	1	-	-	2	2	-	-	-	1	-	-	-
Avg.	2	3	2	-	2	-	-	-	-	-	-	-	1	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

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	Mechanical	Programme Code & Name	114-Mechanical
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Fifth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24501	DESIGN OF MACHINE ELEMENTS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce the design methodology of machine elements. • To acquire knowledge on analysis of forces acting on the machine elements and appropriate design methodology. • To analyses the stresses acting on the temporary and permanent joints. • To gain knowledge about the design of couplings and/or springs. • To teach various standards, and selection procedures of machine elements.					

Unit-I	STRESSES IN MACHINE ELEMENTS	(9)
Procedure in design process - factors influencing machine design - selection of materials based on mechanical properties preferred numbers, fits and tolerance - direct, bending and torsional stress equation - Modes of failure-bending stress incurred beams - crane hook and 'C' frame - factor of safety - theories of failures		
Unit-II	VARIABLE STRESSES AND DESIGN OF SHAFTS	(9)
Variable stresses in machine parts - stress concentration factor - cyclic stresses - fatigue and endurance limit - Goodman and Soderberg methods - combined normal stress and variable stress - design of solid and hollow shafts based on strength and rigidity		
Unit-III	PERMANENT AND TEMPORARY JOINTS	(9)
Welded joints - types - basic weld symbols - strength of transverse and parallel fillet welded joints - eccentrically loaded welded joints. Threaded joints - terms - forms - design of bolted joints under eccentric loading - introduction to riveted joints		
Unit-IV	DESIGN OF COUPLINGS AND SPRINGS	(9)
Couplings - types - design of muff coupling, unprotected type flange coupling, bushed pin flexible coupling Introduction to ELBO flexible pin-type coupling, springs- types, helical springs, materials, end connections, terms used in compression springs - stresses and deflection in helical springs of circular wire - surge in springs - design of leaf springs - stress and deflection equation, nipping		
Unit-V	BEARINGS	(9)
Sliding contact bearings – theory of lubrication, hydrodynamic bearings, Sommerfield number – design of hydrodynamic bearings – rolling contact bearings, static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove ball bearing, Introduction to Magnetic bearings and its applications.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th ed., McGraw-Hill Education, 2015	
2	Bhandari V.B, “Design of Machine Elements”, 4th ed., McGraw Hill Education India Private Limited, 2017	


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REFERENCES:

1	Khurmi. R.S and Gupta. J. K, "A Textbook of Machine Design", S. Chand and Company Ltd., New Delhi, 2014
2	Jalaludeen S. Md, "Machine Design (Volume-1)", 4th ed., Anuradha Publications, Chennai, 2011
3	Sundararajamoorthy T. V. Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2003
4	Robert C. Juvinall, Kurt M. Marshek, "Machine Component Design", Wiley India Pvt Ltd., 2016
5	Ganesh Babu.K, Srithar.K, "Design of Machine Elements", 2nd ed., McGraw Hill Education (India) Private Limited, 2009.

COURSE OUTCOMES:

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

CO1:	Apply concepts of strength of materials to estimate the stresses in a machine element and predict failure of components.
CO2:	Analyse the effect of fatigue load on machine elements and factors affecting it to predict failure.
CO3:	Apply the concepts of Design the machine elements such as Shafts, Keys, springs and bearings
CO4:	Apply the concepts of Design the various joints such as temporary joints, permanent joints and couplings
CO5:	Implement standards, codes, and regulations in machine 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	2	3	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	1	-	-
CO3	3	2	3	3	2	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	-	-
CO5	2	-	3	2	2	1	-	2	-	-	-	3	-	-
Avg.	3	2.2	3	2.2	0.6	0.2	-	0.4	-	-	-	2.2	-	-

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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Fifth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24501	DYNAMICS OF MACHINERY	L	T	P	C	100
		3	0	2	4	
Course Objectives	• To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.					
	• To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.					
	• To understand the effect of Dynamics of undesirable vibrations.					
	• To understand the principles in mechanisms used for speed control and stability control.					

Unit-I	FORCE ANALYSIS	(9)
Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.		
Unit-II	BALANCING	(9)
Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.		
Unit-III	FREE VIBRATION	(9)
Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration–Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.		
Unit-IV	FORCED VIBRATION	(9)
Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.		
Unit-V	MECHANISM FOR CONTROL	(9)
Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
2	Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
3	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCES:

1	Cleghorn.W. L, "Mechanisms of Machines", Oxford University Press, 2014
2	Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3	Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005.
4	Rao.J.S. and Dukkupati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5	Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

List of Exercises/Experiments

1.	Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.	
2.	Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.	
3.	Single degree of freedom Spring Mass System – Determination of natural Frequency	
4.	Multi degree freedom suspension system – Determination of influence coefficient.	
5.	Balancing of rotating & reciprocating masses.	
6.	Transverse vibration of Free-Free beam – with and without concentrated masses.	
7.	Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.	
8.	Determination of gyroscopic effect and couple.	
9.	Critical or Whirling Speed of a Rotating Shaft.	
10.	Determination of torsional natural frequency of single and Double Rotor systems	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Calculate static and dynamic forces of mechanisms.
CO2:	Calculate the balancing masses and their locations of reciprocating and rotating masses.
CO3:	Compute the frequency of free vibration.
CO4:	Compute the frequency of forced vibration and damping coefficient.
CO5:	Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Compound Pendulum	1 No.
2.	Dynamic balancing machine	1 No.
3.	Gyroscopic apparatus	1 No.
4.	Kinematic Models to study various mechanisms	1 No.
5.	Multi Degree Suspension System	1 No.
6.	Spring mass vibration system	1 No.
7.	Transverse vibration setup of cantilever	1 No.
8.	Turn table apparatus	1 No.
9.	Two rotor vibration setup	1 No.
10.	Whirling of shaft apparatus	1 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	3	3	2	-	-	-	-	-	-	3	3	3	3
CO2	3	3	2	3	-	-	-	-	-	-	2	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	2	3	3	3
Avg.	3	3	3	3	-	-	-	-	-	-	2	3	3	3
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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Fifth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24502	METROLOGY AND MEASUREMENTS	L	T	P	C	100
		2	0	2	3	
Course Objectives	To impart knowledge on dimensional, form and surface finish measurement in manufacturing.					

Unit-I	BASICS OF METROLOGY	(9)
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.		
Unit-II	MEASUREMENT OF LINEAR AND ANGULAR 15 DIMENSIONS	(9)
Linear Measuring Instruments – Types – Classification – Limit gauges – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.		
Unit-III	ADVANCES IN METROLOGY	(9)
Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM– Applications – Basic concepts of Machine Vision System – Element – Applications.		
Unit-IV	FORM MEASUREMENT	(9)
Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.		
Unit-V	MEASUREMENT OF POWER, FLOW AND TEMPERATURE	(9)
Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: Reliability and Calibration – Readability and Reliability		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Jain R.K. “Engineering Metrology”, Khanna Publishers, 2005.
2	Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.


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REFERENCES:

1	Charles Reginald Shot bolt, "Metrology for Engineers", 5 th edition, Cengage Learning EMEA, 1990.
2	Back with, Marangoni, Lien hard, "Mechanical Measurements", Pearson Education, 2006.

List of Exercises/Experiments

1.	Calibration of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge using gauge blocks and reporting the calibration uncertainty.	
2.	Tool maker microscope	
3.	Profile projector	
4.	Measurement of angles using bevel protractor and sine bar.	
5.	Bore diameter measurement using micrometer	
6.	Use of mechanical and pneumatic comparators to check the dimensions in a component and variation from the given standard.	
7.	Measurement of surface roughness and roundness in components manufactured using various processes.	
8.	Temperature Measuring Setup	
9.	Force Measuring Setup	
10.	Torque measurement	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Describe the importance of measurement, factors affecting measurement systems, and estimate measurement uncertainty.
CO2:	Explain the working principles and applications of linear and angular measuring instruments (contact and non-contact).
CO3:	Analyze the effect of tolerance in manufacturing and interpret tolerance symbols in engineering drawings to select appropriate processes.
CO4:	Evaluate principles and methods of form and surface finish measurement including straightness, flatness, roundness, threads, and gears.
CO5:	Analyze advanced metrology systems (Laser, CMM, Machine Vision) and describe techniques for measuring power, flow, and temperature in quality control applications.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Autocollimator	1 No.
2.	Bevel Protractor	1 No.
3.	Dial Bore Gauge	1 No.
4.	Force Measuring Setup	1 No.
5.	Gear Tooth Vernier	1 No.
6.	Mechanical Comparator	1 No.
7.	Micrometer	5 Nos.
8.	Pneumatic Comparator	1 No.
9.	Profile Projector	1 No.
10.	Sine Bar	1 No.
11.	Slip Gauge Set	1 No.
12.	Surface finish measuring equipment	1 No.
13.	Temperature Measuring Setup	1 No.
14.	Tool Maker Microscope	1 No.
15.	Vernier Caliper	5 Nos.
16.	Vernier Depth Gauge	2 Nos.
17.	Vernier Height Gauge	2 Nos.

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	2	2
CO2	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO3	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO4	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO5	3	2	2	1	1	-	-	-	1	-	1	3	2	2
Avg.	3	2	2	1	1	-	-	-	1	-	1	3	2	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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Fifth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24503	HEAT AND MASS TRANSFER	L	T	P	C	100
		3	0	2	4	
Course Objectives	• To learn the principal mechanism of heat transfer under steady state and transient conditions.					
	• To learn the fundamental concept and principles in convective heat transfer.					
	• To learn the theory of phase change heat transfer and design of heat exchangers.					
	• To study the fundamental concept and principles in radiation heat transfer.					
	• To develop the basic concept and diffusion, convective di mass transfer.					

Unit-I	CONDUCTION	(9)
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One-Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction.		
Unit-II	CONVECTION	(9)
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate.		
Unit-III	PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS	(9)
Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types –Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods.		
Unit-IV	RADIATION	(9)
Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Radiation Shields.		
Unit-V	MASS TRANSFER	(9)
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion - Stefan flow – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2	Ganesan.V , " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.
3	Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
4	Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011
5	Arora, " Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2010.



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REFERENCES:

1	Nag P.K, “ Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2010
2	Domkundwar, Kothandaraman, & Domkundwar, “ A Course in Thermal Engineering”, 6th Edition, Dhanpat Rai& Sons, 2011.
3	Ananthanarayanan P.N, “ Basic Refrigeration and Air-Conditioning”, 4th Edition, Tata McGraw Hill, 2013
4	Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013.
5	Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.

List of Exercises/Experiments

1.	Thermal conductivity measurement of pipe insulation using two slabs guarded hot plate.	
2.	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.	
3.	Determination of thermal conductivity of an insulating powder.	
4.	Determination of heat transfer coefficient of air under natural convection and forced convection.	
5.	Heat transfer from pin-fin under natural and forced convection.	
6.	Experimental Investigation of Parallel Flow Tube-in-Tube Heat Exchanger Performance	
7.	Determination of heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.	
8.	Determination of Stefan – Boltzmann constant.	
9.	Determination of emissivity of a grey surface.	
10.	Experimental Study on Convective Heat and Mass Transfer in a Cooling Tower.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Apply the conduction equations for steady and transient conditions.
CO2:	Solve problems involving free and forced convection heat transfer.
CO3:	Estimate heat transfer in systems involving radiation heat transfer.
CO4:	Analyse the heat transfer problems in real systems.
CO5:	Relate heat and mass transfer processes.



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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	P S O 3
CO1	3	3	3	3	1	1	1	-	3	3	2	3	3	1
CO2	3	2	2	2	2	1	1	-	1	2	2	2	3	1
CO3	3	2	2	3	3	1	3	2	1	2	3	2	3	3
CO4	2	2	2	1	1	1	2	1	1	1	1	2	2	1
CO5	2	2	3	2	1	2	3	1	1	1	2	1	1	3
Avg.	3	3	3	3	2	2	3	1	2	2	3	3	3	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	Lagged pipe apparatus.	1
2	Composite wall,	1
3	Thermal conductivity of insulating powder apparatus.	1
4	Natural convection test setup.	1
5	Forced convection test setup	1
6	Pin-fin apparatus	1
7	Stefan – Boltzmann constant apparatus.	1
8	Emissivity measurement apparatus.	1
9	Tube-in-tube heat exchanger test setup.	1
10	Cooling tower test setup.	1



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Department	Mechanical	Programme Code & Name				114-Mechanical
Semester						
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	Mechanical	Programme Code & Name	114-Mechanical
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Sixth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24601	FINITE ELEMENT ANALYSIS	L	T	P	C	100
		3	0	2	4	
Course Objectives	- To introduce the concepts of Mathematical Modeling of Engineering Problems. - To appreciate the use of FEM to a range of Engineering Problems. - To give exposure to software tools needed to analyze engineering problems. - To expose the students to different applications of simulation and analysis tools.					

Unit-I	FEM BASICS – VARIATIONAL FORMS, ELEMENT INTERPOLATION	(9)
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.		
Unit-II	ONE-DIMENSIONAL PROBLEMS	(9)
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.		
Unit-III	TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS	(9)
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.		
Unit-IV	TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS	(9)
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.		
Unit-V	ISOPARAMETRIC FORMULATION	(9)
Natural co-ordinate systems – Iso parametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Reddy, J.N. – An Introduction to the Finite Element Method 3rd Edition, McGraw-Hill, 2006
2	S.S.Rao–The Finite Element Method in Engineering 5th Edition, Elsevier, 2010
3	Tirupathi R. Chandrupatla and Ashok D. Belegundu – Introduction to Finite Elements in Engineering 4th Edition, Pearson, 2012


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4	David Hutton – Fundamentals of Finite Element Analysis McGraw-Hill, 2003
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REFERENCES:

1	O.C. Zienkiewicz and R.L. Taylor – The Finite Element Method: Its Basis and Fundamentals 6th Edition, Butterworth-Heinemann, 2005
2	Cook, R.D., Malkus, D.S., Plesha, M.E., Witt, R.J. – Concepts and Applications of Finite Element Analysis 4th Edition, Wiley, 2001
3	Logan, Daryl L. – A First Course in the Finite Element Method 6th Edition, Cengage Learning, 2016
4	K. H. Huebner, D. E. Dewhirst, D. E. Smith, T. G. Byrom – The Finite Element Method for Engineers Wiley-Interscience, 2001
5	O.C. Zienkiewicz and R.L. Taylor – The Finite Element Method: Its Basis and Fundamentals 6th Edition, Butterworth-Heinemann, 2005

List of Exercises/Experiments

1.	Stress and deflection analysis in beams with different support conditions.	
2.	Stress analysis of flat plates and simple shells.	
3.	Stress analysis of axi – symmetric components.	
4.	Thermal stress analysis of plates.	
5.	Vibration analysis of spring-mass systems.	
6.	Model analysis of Beams.	
7.	Analysis of bar element under axial loads and thermal loads	
8.	Analysis of truss structure.	
9.	Steady state heat transfer analysis of composite wall.	
10.	Heat transfer analysis of plates.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Apply the mathematical concepts on solving the Finite Element Problems
CO2:	Statically Analyze the One dimensional problems through FEM technique
CO3:	Statically Analyze the Two dimensional Scalar variable problems through FEM technique
CO4:	Statically Analyze the Two dimensional Vector variable problems through FEM technique
CO5:	Apply the Iso-parametric Formulation to solve structural static and Dynamic problems.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Computer Work Station	15 License
2.	Multibody Dynamic Software Suitable for Analysis	15 License

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	-	3	3	2	-	-
CO2	3	3	3	-	-	-	2	-	-	3	3	3	-	-
CO3	3	3	3	-	-	-	2	1	-	3	3	2	-	-
CO4	3	3	3	-	-	-	2	-	-	3	3	2	-	-
CO5	3	3	3	-	-	-	2	1	-	3	3	3	-	-
Avg.	2	2	3	-	-	-	3	2	-	3	3	3	-	-
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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Sixth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand and apply the fundamental design principles - To analyze complex gear drive problems - To design and draft gearbox layouts - To evaluate mechanical power transmission systems - To implement standards and regulations					

Unit-I	DESIGN OF FLEXIBLE POWER TRANSMISSION SYSTEMS	(9)
Design flat belt and V belt drive based on manufacturer's catalogue- design of transmission chains and sprockets. Introduction to timing belt and silent chain.		
Unit-II	SPUR GEARS AND HELICAL GEARS	(9)
Gear materials- design of straight tooth spur gear & Parallel axis helical gears based on speed ratio, number of teeth, Fatigue strength, Factor of safety, Strength and wear considerations. Forces on teeth-stresses on teeth gear failures-Helical gear-Module-Normal and transverse, Equivalent number of teeth.		
Unit-III	BEVEL AND WORM GEARS	(9)
Straight bevel gear: Gear materials - tooth terminology - tooth forces and stresses – Design of straight bevel gears based on speed ratio, number of teeth, Fatigue strength, Factor of safety, Strength and wear considerations – Worm gear: Gear materials –tooth terminology, Thermal capacity, Forces and stresses, efficiency, design of worm gear drive by checking surface and bending stresses.		
Unit-IV	DESIGN OF GEAR BOXES	(9)
Gear boxes - speed selection - geometric progression - standard step ratio - ray diagram, kinematic layout - design of multistage multi speed constant mesh gear boxes. Introduction to automobile gear box design.		
Unit-V	MOTION CONTROL: CLUTCHES AND BRAKES	(9)
Clutches - types - materials - design of single plate, multi plate and cone clutches - brakes - types - friction materials – design of single block brake, simple band brake, and internal expanding brake. Introduction to Design of Disc brake		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th ed., Tata McGraw-Hill, 2015	
2	Bhandari V.B, “Design of Machine Elements”, 4th ed., McGraw Hill Education India Private Limited, 2017	


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REFERENCES:

1	Spotts M. F, Shoup T. E , Hornberger L.E , David O. Kazmer, “Design of Machine Elements”, 8th ed., Pearson India, 2006
2	Jalaludeen S.Md, “Machine Design (Volume-1)”, 4th ed., Anuradha Publications, Chennai, 2011
3	Sundararamamoorthy T. V. Shanmugam. N, “Machine Design”, Anuradha Publications, Chennai, 2003
4	Robert C. Juvinall, Kurt M. Marshek, “Machine Component Design”, Wiley India Pvt Ltd., 2016
5	Sharma P. C, Aggarwal D. K., “A Textbook of Machine Design” S K Kataria & Sons-New Delhi, 2013

COURSE OUTCOMES:

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

CO1:	Apply fundamental design principles to calculate the parameters for various gear drives, belt drives, chain drives, clutches, and brakes.
CO2:	Analyze complex problems related to spur, helical, bevel and worm gear drives by considering factors like materials, loads, stresses and efficiency.
CO3:	Apply the Design concepts to multistage gear box and draft the kinematic arrangement and ray diagram.
CO4:	Evaluate various mechanical power transmission systems, including belts, chains, gears, gearboxes, clutches, and brakes by using engineering principles and manufacturer data
CO5:	Implement standards, codes, and regulations in transmission system 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	2	3	1	-	-	-	1	-	-	1	2	3	2
CO2	3	2	3	1	-	-	-	1	-	-	1	2	3	2
CO3	3	2	3	1	-	-	-	1	-	-	1	2	3	2
CO4	3	2	3	1	-	-	-	1	-	-	1	2	3	2
CO5	3	2	3	1	-	-	-	1	-	-	1	2	3	2
Avg.	3	2	3	1	-	-	-	1	-	-	1	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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Sixth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEL24602	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C	100
		0	0	4	2	

Course Objectives	- To draw part and Assembly Diagrams of dimensional Components. - To gain practical experience in handling 3D modeling software systems. - To understand the concepts G and M codes and manual part programming. - To understand the applications of various CNC machines and to expose students to modern CNC application machines.
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List of Exercises/Experiments

3D GEOMETRIC MODELLING (30)

1. CAD Introduction

Sketch: Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.

Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.

Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.

Assembly: Constraints, Exploded Views, Interference check Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting

2. CREATION OF 3D ASSEMBLY MODEL OF FOLLOWING MACHINE ELEMENTS USING 3D MODELLING SOFTWARE

1.Flange Coupling

2.Plummer Block

3.Screw Jack

4.Knuckle Joint

5.Universal Joint

6.Machine Vice

7.Stuffing box

8.Connecting rod

* Students may also be trained in manual drawing of some of the above components (specify the number – progressive arrangement of 3D)

3.MANUAL PART PROGRAMMING (30)

1. CNC Machining Centre

i) Linear Cutting.

ii) Circular cutting.

iii) Cutter Radius Compensation.

iv) Canned Cycle Operations.

2. CNC Turning Centre

i) Straight, Taper and Radial Turning.

ii) Thread Cutting.

iii) Rough and Finish Turning Cycle.

iv) Drilling and Tapping Cycle.

Total No of Periods to be Taught	60
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COURSE OUTCOMES:

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

CO1:	Design experience in handling 2D drafting and 3D modelling software systems
CO2:	Create 3Dimensional geometric model of parts, sub-assemblies, assemblies and export it to drawing
CO3:	Generate part programming and simulate the CNC program for Turning and Machining center.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Computer Server	1 No.
2.	Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server	30 Nos.
3.	A3 size plotter	1 No.
4.	Laser Printer	1 No.
5.	CNC Lathe	1 No.
6.	CNC Milling Machine	1 No.
SOFTWARE		
7.	Any High-end integrated modeling and manufacturing CAD software	15 licenses
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15 licenses

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	3	-	-	-	-	-	1	3	3	1
CO2	2	2	2	2	3	-	-	-	-	-	1	3	3	1
CO3	2	2	2	2	3	-	-	-	-	-	1	3	3	1
Avg.	2	2	2	2	3	-	-	-	-	-	1	3	3	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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Sixth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEL24603	MINI PROJECT	L	T	P	C	100
		0	0	4	2	
Course Objectives	• Develop skills to formulate a technical project.					
	• Give guidance on the various tasks of the project and standard procedures.					
	• Give guidance on the various procedures for validation of the product and analyse the cost effectiveness.					
	• To get hands on training in the fabrication of one or more components of a complete working model, this is designed by them.					
	• Provide guidelines to prepare technical report of the project.					

List of Exercises/Experiments

Guideline for Review and Evaluation

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total No of Periods to be Taught	60
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COURSE OUTCOMES:

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

CO1:	Demonstrate the working model of the machine element or the mechanical product.
CO2:	Identify technical ideas, strategies and methodologies.
CO3:	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
CO4:	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
CO5:	Prepare technical report and oral presentations.


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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	2	2	2	2	3	3	3
CO2	3	3	1	-	2	-	1	2	2	2	2	3	3	3
CO3	3	3	1	-	2	-	1	1	2	2	2	3	3	3
CO4	3	3	1	-	2	-	1	1	2	2	2	3	3	3
CO5	3	3	1	-	1	-	1	1	2	2	2	3	3	3
Avg.	3	3	1	-	1.6	-	1	1.4	2	2	2	3	3	3
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

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/arithmatic-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	Mechanical	Programme Code & Name	114-Mechanical
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Seventh Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24601	DESIGN OF TRANSMISSION SYSTEMS	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.		
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.		
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.		
Unit-IV	SOCIAL ETHICS	(6)
Gear boxes - speed selection - geometric progression - standard step ratio - ray diagram, kinematic layout - design of multistage multi speed constant mesh gear boxes. Introduction to automobile gear box design.		
Unit-V	SCIENTIFIC ETHICS	(6)
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.		
Total No of Periods to be Taught		30
TEXT BOOK:		
1	The Nonreligious: 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, Oxford University Press, 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 Soumitro Banerjee, IISc Press, January 2022	


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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 CO5 :
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	-	-	-	-	-	3	3	2	2	-	-	2	-	-
CO2	-	-	-	-	-	2	2	3	3	2	-	2	-	-
CO3	-	-	2	2	2	3	2	3	3	3	-	3	2	-
CO4	-	-	-	-	-	3	3	3	3	3	-	2	-	-
CO5	-	2	3	2	2	2	2	3	2	3	2	3	2	-
Avg.	-	0.4	0.4	0.8	0.8	2.6	2.4	2.8	2.6	2.2	0.4	2.4	0.8	-

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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Seventh Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMET24702	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 - To understand about the organizational theory in professional organization. - To learn the principles of productivity and modern concepts in management in professional organization.					

Unit-I	INTRODUCTION TO MANAGEMENT	(9)
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol– 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 – I	(9)
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.		
Unit-III	FUNCTIONS OF MANAGEMENT– II	(9)
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake- Mouton, 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)
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–Change Management: Concept of Change; Lewin’s Process of Change Model.		
Unit-V	PRODUCTIVITY AND MODERN TOPICS	(9)
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2009.
2	Koontz.H.andWeihrich.H.,“Essentials of Management: An International Perspective”, 8th Edition, Tata McGraw-Hill, New Delhi, 2010.

REFERENCES:

1	Joseph J. Massie, “Essentials of Management”, 4th 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	Richard L. Daft, “Organization Theory and Design”, South Western College Publishing, 11th 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:	Understand about the basic concepts, approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
CO2:	Understand about 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

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	2	3	2	3	1	1	1	1
CO2	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO3	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO4	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO5	1	1	1	1	1	3	2	3	2	3	1	1	1	1
Avg.	1	1	1	1	1	3	2	3	2	3	1	1	1	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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Seventh Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMETL24701	MECHATRONICS AND IOT	L	T	P	C	100
		3	0	2	4	
Course Objectives	To impart knowledge on the principles of sensors, actuators, micro-controllers, Programmable Logic control, Arduino, Raspberry Pi and IOT.					

Unit-I	SENSORS AND ACTUATORS	(9)
Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors.		
Unit-II	SIGNAL CONDITIONING CIRCUITS AND PLC	(9)
Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System, Switching Loads by Power Semiconductor Devices Circuits – Thyristors – TRIAC – Darlington Pair – MOSFET and Relays. PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.		
Unit-III	FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS	(9)
The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single- Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - Software Considerations.		
Unit-IV	ARDUINO AND RASPBERRY PI	(9)
Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor – Temperature sensor- Humidity sensor - Sensor and Actuator interactions.		
Unit-V	MECHATRONICS AND IoT CASE STUDIES	(9)
Lasers in metrology - Advantages of lasers – Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi-sensor CMMs – Articulated CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production; Digital Metrology solutions – X ray Computed tomography; White light Scanners / Structured light scanners; Metrology for e-mobility; Role of Metrology in I4.0 / Smart Manufacturing, Requirements for Metrology for I4.0.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products and Processes”, Routledge, 2017.
2	Sami S.H and Kisheen Rao G, “The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers”, CRC Press, 2022.

REFERENCES:

1	John Billingsley, “Essentials of Mechatronics”, Wiley, 2006
2	David H., Gonzalo S., Patrick G., Rob B. and Jerome H., “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2018.
3	Newton C. Braga, “Mechatronics For The Evil Genius”, McGraw Hill, 2005.
4	Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013.
5	Nitin G and Sharad S, “Internet of Things: Robotic and Drone Technology”, CRC Press, 2022.

List of Exercises/Experiments

1.	Addition, Subtraction and Multiplication Programming in 8051.	
2.	Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.	
3.	Programming and Interfacing of Traffic Light Interface using 8051..	
4.	Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.	
5.	IoT based Home Automation.	
6.	Familiarization with concept of IoT and its open source microcontroller/SBC.	
7.	Write a program to turn ON/OFF motor using microcontroller/SBC through internet.	
8.	Write a program to interface sensors to display the data on the screen through internet.	
9.	To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/wifi.	
10.	To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.	
Total No of Periods to be Taught		30

COURSE OUTCOMES:

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

CO1:	Select suitable sensors and actuators to develop mechatronics systems
CO2:	Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.
CO3:	Elucidate the fundamentals of IoT and Embedded Systems.
CO4:	Implement Arduino and Raspberry Pi as controllers for automated systems.
CO5:	Design and develop an apt mechatronics/IoT based system for the given real- time application.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Embedded and IoT Trainer Kit	5 Nos.
2.	Hydraulic Trainer Kit	1 No.
3.	8051 Microcontroller trainer kit	2 Nos.
4.	Electro Pneumatic with PLC	2 Nos.
5.	PID Controller Trainer Kit	1 No.
6.	Traffic light control interfacing card compatible with 8086 & 8051 kits	2 Nos.

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	2	3
CO2	3	3	3	1	2	-	-	-	-	-	-	1	2	3
CO3	3	1	2	1	2	-	-	-	-	-	-	1	2	3
CO4	3	3	3	3	3	2	-	-	-	-	-	1	2	3
CO5	3	3	3	3	3	2	-	-	-	-	2	1	2	3
Avg.	3	2.4	2.4	1.8	2.8	2	-	-	-	-	2	1	2	3
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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Eighth Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEL24801	PROJECT WORK / INTERNSHIP	L	T	P	C	100
		0	0	20	10	
Course Objectives	- The objective of this course is to help the students to develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination. - The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. - The progress of the project is evaluated based on a minimum of three reviews. - The review committee may be constituted by the Head of the Department. - A project report is required at the end of the semester. - The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.					

Total No of Periods to be Taught	300
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COURSE OUTCOMES:

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

CO1:	Take up any challenging practical problems and find solution by formulating proper methodology
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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	1	1	1	1	1	1	1	1	1
Avg.	1	1	1	1	1	1	1	1	1	1	1	1	1	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2401	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To study the various design requirements and get acquainted with the processes involved in product development. - To study the design processes to develop a successful product. - To learn scientific approaches to provide design solutions. - Designing solution through relate the human needs and provide a solution. - To study the principles of material selection, costing and manufacturing in design.					

Unit-I	INTRODUCTION	(9)
Definition-various methods and types of design-importance of product design-various design projects morphology of design-requirements of a good design-design guidelines-design catalogs-code and standards design product and process cycles-bench marking.		
Unit-II	INTRODUCTION TO DESIGN PROCESSES	(9)
Basic modules in design process-scientific method and design method- identification, importance of problem structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- Detail design and engineering drawings-prototyping and testing-Design for X.		
Unit-III	CREATIVITY IN DESIGN	(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)
Creativity and problem solving-vertical and lateral thinking-invention, innovation, diffusion-psychological view, mental blocks- Creativity methods-brainstorming, mind map, concept map-Theory of innovative problem solving (TRIZ) –Axiomatic design.		
Unit-V	MATERIAL AND PROCESSES IN DESIGN	(9)
Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems-Design for Manufacture (DFM)-Design for Assembly (DFA).		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013.	
2	Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.	


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REFERENCES:

1	Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, "Integrated Product and Process Design and Development", CRC Press, 2009.
2	Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

COURSE OUTCOMES:

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

CO1:	Analyze the various design requirements and get acquainted with the processes involved in product development.
CO2:	Apply the design processes to develop a successful product.
CO3:	Apply scientific approaches to provide design solutions.
CO4:	Design solution through relate the human needs and provide a solution.
CO5:	Apply the principles of material selection, costing and manufacturing in 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	2	3	-	1	-	-	-	-	-	-	-	3	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	3	1	-	-	-	-	-	-	-	2	-	-
CO4	-	2	3	-	1	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	2	-	1	2	1	-	-
Avg.	2.3	2.5	2.3	2	1	-	-	-	-	1	2	1.8	-	-

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

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Department	Mechanical	Programme Code & Name			114-Mechanical	
Professional Electives - (Stream – I Engineering Design)						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2402	CAD/ CAM	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To Introduce and understand the Basic of Design. - To study the two-dimensional drafting and bill of material creation. - To learn three-dimensional modelling and its advantages. - To study the basic and purpose of assembling modelling - To study the basics of computer aided machining and part programming.					

Unit-I	BASICS OF DESIGNS	(9)
Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings – Customer Specific requirements – Drawing Grid reading		
Unit-II	2D DRAFTING	(9)
Projection views – Orthographic view, Axillary view, Full view, Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting		
Unit-III	3D MODELING	(9)
Conversion of Views – 2D to 3D, 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body in White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.		
Unit-IV	ASSEMBLY MODELING	(9)
Basics of Assembly modeling, Purpose of Assembly modeling its advantages – Top to Down – Bottom Up modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis – Cumulative effect of Tolerances in after assembly conditions.		
Unit-V	CAM	(9)
Basics of CNC Machining – 3, 4, 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation – Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Computer Aided Design & Manufacturing - Jacob Moses & Ruchi Agarwal	
2	CAD / CAM Principles & Application - J. Srinivas	


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REFERENCES:

1	CAD / CAM - Ibrahim Zaid (Text & Reference Book)
2	CAD / CAM – Chandandeep Grewal
3	CAD CAM & Automation – Farazdak Haideri (Text & Reference Book)
4	CAD / CAM – PN Rao

COURSE OUTCOMES:

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

CO1:	Discuss the basics of the design and concepts.
CO2:	Develop the two-dimensional drafting and projection views.
CO3:	Discuss the three-dimensional modeling, parametric and non-parametric modeling
CO4:	Discuss the assembly modeling and top down, bottom-up approaches.
CO5:	Develop the computer aided machining and writing part programming.

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	2	2	2	2	-	-	-	1	-	1	3	3	2
CO2	3	2	2	2	2	-	-	-	1	-	1	3	3	2
CO3	3	2	2	2	2	-	-	-	1	-	1	3	3	2
CO4	3	2	2	2	2	-	-	-	1	-	1	3	3	2
CO5	3	2	2	2	2	-	-	-	1	-	1	3	3	2
Avg.	3	2	2	2	2	-	-	-	1	-	1	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2403	SURFACE ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To study the fundamentals of surface features and different types of friction associated with metals and non-metals. • To study the different types of wear mechanism and its standard measurement. • To study the different types of corrosion and its preventive measures. • To study the different types of surface properties and surface modification techniques. • To study the various types of materials used in the friction and wear applications					

Unit-I	SURFACES AND FRICTION	(9)
Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.		
Unit-II	WEAR	(9)
Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements		
Unit-III	CORROSION	(9)
Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.		
Unit-IV	SURFACE TREATMENTS	(9)
Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.		
Unit-V	ENGINEERING MATERIALS	(9)
Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	G.W .Stachowiak and A.W.Batchelor, “Engineering Tribology”, Butterworth-Heinemann, 2005.	
2	S.K. Basu, S.N.Sengupta and B.B.Ahuja, ”Fundamentals of Tribology”, Prentice Hall of India, 2005.	


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REFERENCES:

1	Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
2	Halling, J. (Editor), "Principles of Tribology ", MacMillian, 1984.
3	Rabinowicz.E., "Friction and Wear of materials", John Willey & Sons, 1995.
4	Williams J.A., "Engineering Tribology", Oxford University Press, 1994.
5	Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

COURSE OUTCOMES:

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

CO1:	Describe the fundamentals of surface features and different types of friction associated with metals and non-metals.
CO2:	Analyze the different types of wear mechanism and its standard measurement.
CO3:	Analyze the different types of corrosion and its preventive measures.
CO4:	Analyze the different types of surface properties and surface modification techniques.
CO5:	Analyze the various types of materials used in the friction and wear 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	2	2	-	-	2	1	-	2	3	2	1
CO2	2	2	2	2	2	-	-	2	1	-	2	3	2	1
CO3	1	2	2	2	2	-	-	2	1	-	2	2	3	1
CO4	1	2	2	2	2	-	-	2	1	-	2	2	3	1
CO5	1	1	2	2	2	-	-	2	1	-	2	2	2	1
Avg.	1	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	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2404	ROBOTICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To learn about basics of robots and their classifications. - To understand the robot kinematics in various planar mechanisms. - To learn about the concepts in robot dynamics. - To understand the concepts in trajectory planning and programming. - To know about the various applications of robots.					

Unit-I	BASICS OF ROBOTICS	(9)
Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.		
Unit-II	ROBOT KINMEATICS	(9)
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms		
Unit-III	ROBOT DYNAMICS	(9)
Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation		
Unit-IV	TRAJECTORY, PATH PLANNING AND PROGRAMMING	(9)
Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS.		
Unit-V	ROBOT AND ROBOT APPLICATIONS	(9)
Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.
2	K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCES:

1	M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2 nd Edition, 2012.
2	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2 nd Edition, 2010.
3	S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800.
4	SathyaRanjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

COURSE OUTCOMES:

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

CO1:	State the basic concepts and terminologies of robots
CO2:	Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots
CO3:	Derive the Forward and Inverse Kinematics, Dynamics for Various Robots
CO4:	Apply the various programming techniques in industrial applications
CO5:	Analyze the use of various types of robots in different applications

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	2	3	1	2	-	-	-	-	-	1	2	1	3
CO2	3	2	3	1	2	-	-	-	-	-	1	2	1	3
CO3	3	2	3	1	2	-	-	-	-	-	1	2	1	3
CO4	3	2	3	1	2	-	-	-	-	-	1	2	2	3
CO5	3	2	3	1	3	-	-	-	-	-	1	2	2	3
Avg.	3	2	3	1	2.2	-	-	-	-	-	1	2	1.4	3

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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2405	MANUFACTURING SYSTEM DESIGN	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the structure and components of manufacturing systems. - To develop capability to design, analyze, and evaluate manufacturing systems. - To understand layout planning, cellular manufacturing, and line balancing. - To study scheduling strategies, automation, and flexible systems. - To apply simulation and optimization in system design					

Unit-I	INTRODUCTION TO MANUFACTURING SYSTEMS	(9)
Types of manufacturing systems – Job shop, batch, mass, cellular – System components – System design process – Types of product and process flow – Performance metrics.		
Unit-II	FACILITY LAYOUT AND CELLULAR MANUFACTURING	(9)
Principles of facility layout – Types: process, product, fixed-position – Computerized layout planning – Group technology – Cell formation algorithms – Rank order clustering – Production flow analysis.		
Unit-III	LINE BALANCING AND ASSEMBLY SYSTEMS	(9)
Assembly line types – Line balancing problems – Heuristic methods – Largest Candidate Rule (LCR), Kilbridge and Wester Method – Mixed-model assembly lines – Workstation design – Material supply strategies.		
Unit-IV	SCHEDULING AND CONTROL SYSTEMS	(9)
Shop floor control – Priority rules – Job sequencing techniques – Dispatching rules – Bottleneck scheduling – Kanban and CONWIP systems – Agile manufacturing and Just-In-Time concepts.		
Unit-V	FLEXIBLE MANUFACTURING AND SYSTEM SIMULATION	(9)
FMS components and layout – Routing flexibility – Automated storage and retrieval systems (AS/RS) – Simulation models of manufacturing systems – Discrete-event simulation – Case studies using ARENA / Flex Sim.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	N. Viswanadham and Y. Narahari, Performance Modeling of Automated Manufacturing Systems, Prentice Hall of India.
2	G. Boothroyd, C. Poli, and L. Murch, Product Design for Manufacture and Assembly, CRC Press.


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REFERENCES:

1	S. Kumar, Manufacturing System Design and Analysis, Prentice Hall
2	J. T. Black and S. L. Hunter, Lean Manufacturing Systems and Cell Design, Society of Manufacturing Engineers
3	T. A. MikellGroover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson
4	Kelton, W.D., Sadowski, R.P., and Sturrock, D.T., Simulation with Arena, McGraw-Hill

COURSE OUTCOMES:

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

CO1:	Understand different types and characteristics of manufacturing systems.
CO2:	Design effective layouts and implement cellular manufacturing techniques.
CO3:	Apply line balancing strategies for efficient assembly line design.
CO4:	Develop job scheduling and control strategies for manufacturing operations
CO5:	Analyze and optimize manufacturing systems using simulation tools.

Mapping of COs with POs and PSOs

COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	2	-	-	-	-	1	-	-	-	-
CO5	2	3	3	3	3	-	-	-	-	2	1	-	-	-
Avg.	2.8	2.6	3	2	1.4	-	-	-	-	0.6	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2406	DESIGN FOR MANUFACTURING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products. - To learn design consideration principles of forming in the design of extruded, stamped, and forged products. - To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products. - To learn design consideration principles of welding in the design of welded products. - To learn design consideration principles of assembly in the design of assembled products					

Unit-I	INTRODUCTION AND CASTING	(9)
Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent Mold cast parts.		
Unit-II	FORMING	(9)
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts.		
Unit-III	MACHINING	(9)
Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.		
Unit-IV	WELDING	(9)
Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment& heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.		
Unit-V	ASSEMBLY	(9)
Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986.
2	O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.


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REFERENCES:

1	CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2	David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3	Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4	Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
5	Matousek, "Engineering Design", Blackie & Sons, 1956.

COURSE OUTCOMES:

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

CO1:	Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
CO2:	Explain design consideration principles of forming in the design of extruded, stamped, and forged products.
CO3:	Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
CO4:	Explain design consideration principles of welding in the design of welded products.
CO5:	Explain design consideration principles of assembly in the design of assembled 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	3	3	3	1	-	-	-	-	-	-	1	2	2	1
CO2	3	3	3	1	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	1	-	-	-	-	-	-	1	2	2	1
CO4	3	3	3	1	-	-	-	-	-	-	1	2	2	1
CO5	3	3	3	1	-	-	-	-	-	-	1	2	2	1
Avg.	3	3	3	1	-	-	-	-	-	-	1	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2408	DESIGN OF JIGS AND FIXTURES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the functions and design principles of Jigs, fixtures and press tools - To gain proficiency in the development of required views of the final design.					

Unit-I	LOCATING AND CLAMPING PRINCIPLES	(9)
Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements –principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.		
Unit-II	JIGS AND FIXTURES	(9)
Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.		
Unit-III	PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES	(9)
Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.		
Unit-IV	BENDING AND DRAWING DIES	(9)
Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads –Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.		
Unit-V	FORMING TECHNIQUES AND EVALUATION	(9)
Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
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2	Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996
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REFERENCES:

1	ASTME Fundamentals of Tool Design Prentice Hall of India.
2	Design Data Hand Book, PSG College of Technology, Coimbatore.
3	Donaldson, Lecain and Goold “Tool Design”, 5th Edition, Tata McGraw Hill, 2017.
4	Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5	Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.
6	Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.

COURSE OUTCOMES:

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

CO1:	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
CO2:	Design and develop jigs and fixtures for given component
CO3:	Discuss the press working terminologies and elements of cutting dies
CO4:	Distinguish between Bending and Drawing dies.
CO5:	Discuss the different types of forming techniques

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	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO2		-	-	-	1	1	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-	-	-
CO4		-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	2	2	2	2	-	-	-	1	1	-	-	-	-	-
Avg.	2	1	2	1	-	-	-	1	1	-	-	-	-	-

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


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Department	Mechanical	Programme Code & Name			114-Mechanical	
Professional Electives - (Stream – I Engineering Design)						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2408	DESIGN OF MATERIAL HANDLING EQUIPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	To impart students on the need, use, application and design of different material handling techniques, equipments and machines used in common use and in industrial sector.					

Unit-I	FUNDAMENTALS OF MATERIAL HANDLING	(9)
Principles of material handling – Types of material handling systems – Selection criteria – Unit load and bulk load – Classification and choice – Automation in material handling – Layout considerations.		
Unit-II	DESIGN OF HOISTING EQUIPMENT	(9)
Components: hoists, ropes, pulleys, sheaves, drums – Design of hoisting elements – Rope selection – Pulley design – Design of screw and chain hoists – Load analysis.		
Unit-III	DESIGN OF CRANES AND ELEVATORS	(9)
Types of cranes: EOT, jib, gantry – Design of bridge, end carriage, gantry girder – Elevators and their classification – Hydraulic and electric lifts – Cabin design – Counterweight and safety gear.		
Unit-IV	DESIGN OF CONVEYORS	(9)
Types: belt, chain, screw, pneumatic – Belt conveyor components – Design for belt width, speed, idlers – Chain and screw conveyor calculations – Tension and power requirement – Layout optimization.		
Unit-V	STORAGE AND HANDLING OF BULK MATERIALS	(9)
Hoppers and silos – Design considerations – Flow patterns – Angle of repose – Vibratory feeders – Bins and storage systems – Automated Storage and Retrieval Systems (ASRS).		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Material Handling Equipments by Rudenko, MIR Publishers
2	Alexandrov M., “Materials Handling Equipments”, MIR Publishers, 1981.
3	Spivakovskii, “Conveyors and related equipments”. MIR publishers.

REFERENCES:	
1	Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2	Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.


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3	Lingaiah. K. and Narayanalyengar, "Machine Design Data Hand Book", Vol.1 & 2, Suma Publishers, Bangalore, 1983
4	P.S.G. Tech., "Design Data Book", KalaikathirAchchagam, Coimbatore, 2003.
5	Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.

COURSE OUTCOMES:

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

CO1:	Understand the need and classification of material handling systems
CO2:	Analyze different types of material handling equipment like conveyors, hoists, etc.
CO3:	Design components of hoisting equipment such as ropes, pulleys, drums, brakes
CO4:	Apply principles to design conveyors, cranes, and lifting devices
CO5:	Evaluate safety, ergonomics, and performance factors in the selection of equipment

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	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	1	-	-	-
CO4	3	3	3	2	1	-	-	-	-	1	1	-	-	-
CO5	2	2	3	2	-	-	2	2		2	2	-	-	-
Avg.	2.8	2.6	2.4	1.4	0.2	-	0.4	0.4		0.6	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2409	INDUSTRIAL LAYOUT DESIGN AND SAFETY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis. - To learn the facilities layout design algorithms and selecting appropriate software. - To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling. - To learn the safety planning and management principles in industries. - To learn the various safety management approaches in industries.					

Unit-I	INTRODUCTION	(9)
Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.		
Unit-II	FACILITIES LAYOUT DESIGN & ALGORITHMS	(9)
Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation)		
Unit-III	FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS	(9)
Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.		
Unit-IV	SAFETY PLANNING & MANAGEMENT	(9)
Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.		
Unit-V	APPROACHES IN SAFETY MANAGEMENT	(9)
Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Sunderesh S. Heragu, "Facilities Design", 3rd Edition, CRC Press Taylor & Francis Group, 2008.
2	L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", Tata McGraw-Hill Publishing Co. Ltd., 2005.

REFERENCES:

1	Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw-Hill Publishing Co. Ltd., 2001
2	James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, "Facilities Planning", 4th Edition, John Wiley & Sons, 2010
3	Matthew P. Stevens and Fred E. Meyers, "Manufacturing Facilities Design and Material Handling", 5th Edition, Purdue University Press, 2013.
4	Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.
5	J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
6	Industrial Hazard and Safety Handbook: (Revised impression by Ralph W King and John Magid 24 September 2013

COURSE OUTCOMES:

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

CO1:	Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
CO2:	Describe the facilities layout design algorithms and selecting appropriate software.
CO3:	Describe the facilities layout problem modeling tools and algorithms for production, warehouse, and material handling.
CO4:	Explain the safety planning and management principles in industries.
CO5:	Illustrate the various safety management approaches in 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	1	2	2	2	1	3	3	3	2	1	3	2	2	2
CO2	1	2	2	2	1	3	3	3	2	1	3	2	2	2
CO3	1	2	2	2	1	3	3	3	2	1	3	2	2	2
CO4	1	2	2	2	1	3	3	3	2	1	3	2	2	2
CO5	1	2	2	2	1	3	3	3	2	1	3	2	2	2
Avg.	1	2	2	2	1	3	3	3	2	1	3	2	2	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2410	NANO TECHNOLOGY	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	(8)
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	(8)
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	(10)
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	(10)
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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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B

Mecheri, Salem Dt-636453, Tamilnadu



TEXT BOOK:

1	MickWilson,KamaliKannangara,GeoffSmith,MichelleSimmom,BurkhardRaguse,“Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas PressG.
2	Cao,“Nanostructures&Nanomaterials:Synthesis,Properties&Applications”Imperial College Press, 2004
3	William AGoddard“Handbook of Nanoscience, EngineeringandTechnology”, 3 rd Edition, CRC Taylor and Francis group 2012.

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,TheChemistryofNanomaterials:Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH VerlagGibtI& Co
3	IvorBrodieandJuliusJ.Muray,'ThephysicsofMicro/Nano–Fabrication',Springer International Edition,2010

COURSE OUTCOMES:

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

CO1:	Understandthebasicproptiessuchasstructural,physical,chemicalpropertiesof nanomaterials and their applications
CO2:	Able to acquire knowledge about the different types of nano material synthesis
CO3:	Describesabouttheshape,size, structureofcompositenonmaterial'sandtheir interference
CO4:	Understandthedifferentcharacterizationtechniquesfornonmaterial's
CO5:	Developadeeperknowledgeintheapplicationofnonmaterial'sindifferentfields.

Mapping of COs with POs and PSOs

COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
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	3
CO5	2	2	1	3	3	1	1	1	1	-	2	2	1	3
Avg.	3	2	2	1	3	3	1	1	1	1	2	3	2	1

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


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Mecheri, Salem Dt-636453, Tamilnadu



Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2411	NEW PRODUCT DEVELOPMENT	L 3	T 0	P 0	C 3	100
Course Objectives	- To introduce the fundamental concepts of the new product development - To develop material specifications, analysis and process. - To Learn the Feasibility Studies & reporting of new product development. - To study the new product qualification and Market Survey on similar products of new product development - To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model					

Unit-I	FUNDAMENTALS OF NPD	(8)
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	MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS	(9)
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.		
Unit-III	ESSENTIALS OF NPD	(9)
RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.		
Unit-IV	CRITERIONS OF NPD	(9)
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.		
Unit-V	REPORTING & FORWARD-THINKING OF NPD	(9)
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Product Development – StenJonsson
2	Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:

1	Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark Change by Design
2	Toyota Product Development System – James Morgan & Jeffrey K. Liker Product Design & Value Engineering – Dr. M.A. Bulsara&Dr. H.R. Thakkar

COURSE OUTCOMES:

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

CO1:	Discuss fundamental concepts and customer specific requirements of the New Product development
CO2:	Discuss the Material specification standards, analysis and fabrication, manufacturing process.
CO3:	Develop Feasibility Studies & reporting of New Product development
CO4:	Analyzing the New product qualification and Market Survey on similar products of new product development
CO5:	Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

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	-	1	1	3	2
CO2	2	1	3	1	-	-	-	1	1	-	1	1	3	2
CO3	2	1	3	1	-	-	-	1	1	-	1	1	3	2
CO4	2	1	3	1	-	-	-	1	1	-	1	1	3	2
CO5	2	1	3	1	-	-	-	1	1	-	1	1	3	2
Avg.	2	1	3	1	-	-	-	1	1	-	1	1	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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Professional Electives - (Stream – I Engineering Design)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2412	AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING	L	T	P	C	100
		2	0	2	3	
Course Objectives	• To analyze and prioritize functional requirements of engine components while critically assessing suitable materials for optimal performance • To design cylinder and piston components • To design connecting rod and crank shaft • To design of flywheel and valve train • To describe the Engine Testing cycles, Emission measurement technologies					

Unit-I	FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS	(6)
Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.		
Unit-II	DESIGN OF CYLINDER AND PISTON COMPONENTS	(6)
Design of cylinder, cylinder head, piston, piston rings and piston pin.		
Unit-III	DESIGN OF CONNECTING ROD AND CRANK SHAFT	(6)
Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.		
Unit-IV	DESIGN OF FLYWHEEL AND VALVE TRAIN	(6)
Design of valve – inlet valve – exhaust valve - Valve springs – Camshafts – SOHC & DOHC– tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub – arm.		
Unit-V	ENGINE TESTING	(6)
Engine test cycles – Worldwide harmonized Light-duty vehicles Test Cycles ((WLTC) – World Harmonized Stationary Cycle (WHSC) – World Harmonized Vehicle Cycle (WHVC) – Nonroad Transient Cycle (NRTC) – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO2 - HC.- Particle counter, Current Standards followed in India for Engine Testing.		
Total No of Periods to be Taught		30

TEXT BOOK:

1	Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2	The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello 24 December 2019


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REFERENCES:

1	Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England.
2	Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
3	Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, MohamadMidani, et al. 9 August 2021.
4	Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach 6 June 2015.
5	Advanced Technology for Design and Fabrication of Composite Materials and Structures: Applications to the Automotive, Marine, Aerospace and ... Applications of Fracture Mechanics) by George C. Sih, Alberto Carpinteri, et al. 15 December 2010.

List of Exercises/Experiments

1.	Design and animate Piston Cylinder assembly and motion study using CAD software.
2.	Design and simulate Connecting rod and crank shaft
3.	Design flywheel and valve
4.	Design and simulate Two Cylinder Engine assembly using CAD software.
5.	Conduct the engine performance test
6.	Conduct the emission test
7.	Tensile test on automotive materials using Universal Testing Machine
8.	Hardness test on automobile components
9.	Impact test on engineering materials
10.	Microstructure analysis using metallurgical microscope

COURSE OUTCOMES:

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

CO1:	Apply knowledge to select suitable materials for various engine components based on their functional requirements.
CO2:	Design the cylinder and piston components considering engineering principles and material properties.
CO3:	Apply analytical skills to design a connecting rod and crankshaft under different loading conditions.
CO4:	Design a flywheel and valve train design to meet specified performance criteria.
CO5:	Demonstrate the engine testing procedures and current standards followed in India for engine testing.


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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	CAD Workstations	30
2.	Simulation Software	30
3.	IC Engine Test Rig	1
4.	Dynamometer	1
5.	Exhaust Gas Analyzer	1
6.	Smoke Meter	1
7.	Precision Measuring Instruments	2
8.	Tool Kit and Safety Equipment	1
9.	Universal Testing Machine (UTM)	1
10.	Hardness Testing Machine	1
11.	Impact Testing Machine	1
12.	Metallurgical Microscope	2

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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	3	3	-	-	2	-	-	-
Avg.	3	3	-	-	-	-	3	3	-	-	2	3	-	-

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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2413	AUTOMOTIVE SYSTEMS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the construction and working principle of various parts of an automobile. - To identify the systems and sub-systems of a typical automobile - To analyse Steering, Suspension, Braking systems, Power transmission system and its components - To have the practice for assembling and dismantling of engine parts and transmission system					

Unit-I	VEHICLE STRUCTURE AND ENGINES	(9)
Types of automobiles, vehicle construction and different layouts, chassis, frame and body, vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).		
Unit-II	ENGINE AUXILIARY SYSTEMS	(9)
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and Common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).		
Unit-III	TRANSMISSION SYSTEMS	(9)
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.		
Unit-IV	STEERING, BRAKES AND SUSPENSION SYSTEMS	(9)
Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.		
Unit-V	ALTERNATIVE ENERGY SOURCES	(9)
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with alternate fuels - Electric and Hybrid vehicles, Fuel Cells.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, NewDelhi, 2002.	
2	Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, NewDelhi, 13th Edition 2014.	


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REFERENCES:

1	Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw Hill, 2012.
2	Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3	Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4	Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Goodheart - Will Cox Company Inc, USA ,1978.
5	Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

COURSE OUTCOMES:

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

CO1:	Understand the construction and working principle of various parts of an automobile.
CO2:	Identify various systems and sub-systems such as injection and ignition system
CO3:	Study power train system of automobile
CO4:	Analyse Steering, Suspension, Braking systems and its components.
CO5:	Predict alternative fuels and energy sources in automobile

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	-	-	-	2	1	2	-
CO2	3	2	-	-	-	-	1	-	-	-	2	1	2	-
CO3	3	2	-	-	-	-	1	-	-	-	2	1	2	-
CO4	3	2	-	-	-	-	1	-	-	-	2	1	2	-
CO5	3	2	-	-	-	-	1	-	-	-	2	1	2	-
Avg.	3	2	-	-	-	-	1	-	-	-	2	1	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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2414	SOLAR ENERGY SYSTEMS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To understand solar radiation principles and their measurement. • To study the components and design of solar thermal and photovoltaic systems. • To apply solar energy for heating, power generation, and industrial uses. • To evaluate the performance and economics of solar energy systems.					

Unit-I	SOLAR RADIATION	(9)
Solar angles – Sun path diagram – Solar radiation measurement – Estimation of solar radiation – Radiation on tilted surfaces – Atmospheric effects – Data sources.		
Unit-II	SOLAR THERMAL COLLECTORS	(9)
Flat plate collectors – Evacuated tube collectors – Concentrating collectors – Performance analysis – Efficiency calculations – Testing standards.		
Unit-III	SOLAR THERMAL SYSTEMS	(9)
Water heating systems – Space heating/cooling – Solar cooking – Drying – Solar thermal power generation (parabolic trough, dish, central receiver) – Design and performance analysis.		
Unit-IV	SOLAR PHOTOVOLTAIC SYSTEMS	(9)
Principle of photovoltaic conversion – Types of PV cells – I-V characteristics – PV modules and arrays – Balance of systems – Solar inverters – Applications – PV system sizing and design.		
Unit-V	SYSTEM DESIGN & ECONOMICS	(9)
Hybrid solar systems – MPPT and battery storage – Economic analysis: Payback period, LCOE – Environmental impact – Government incentives and case studies in India.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	S.P. Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 3rd Edition.	
2	Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, 4th Edition.	

REFERENCES:	
1	Duffie, J.A., and Beckman, W.A., Solar Engineering of Thermal Processes, Wiley.
2	Kalogirou, S.A., Solar Energy Engineering: Processes and Systems, Elsevier.
3	Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers.


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COURSE OUTCOMES:

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

CO1:	Understand the basic concepts of solar radiation and estimation methods.
CO2:	Explain the working principles and analyze performance of solar thermal collectors.
CO3:	Design and evaluate solar thermal systems for various thermal applications.
CO4:	Analyze and size photovoltaic systems for different applications.
CO5:	Assess solar system economics and environmental impact for decision-making.

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	1	2
CO2	3	3	2	-	-	-	-	-	-	-	1	3	1	2
CO3	3	3	3	2	-	-	-	-	-	-	1	3	1	2
CO4	3	3	3	3	-	-	-	-	-	-	1	3	1	2
CO5	2	3	3	-	2	3	-	-	-	-	1	3	1	2
Avg.	2.8	2	2.6	1	0.4	0.6	-	-	-	-	1	3	1	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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2415	INTERNAL COMBUSTION ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To study the working of Gasoline fuel injection systems and SI combustion.					
	• To study the working of Diesel fuel injection systems and CI combustion.					
	• To Identifying the source and measure it; explain the mechanism of emission formation and control methods.					
	• To study the Selecting alternative fuel resources and its utilization techniques in IC engines.					
	• To study the air conditioning systems and load estimation.					

Unit-I	SPARK IGNITION ENGINES	(9)
Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.		
Unit-II	COMPRESSION IGNITION ENGINES	(9)
Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.		
Unit-III	EMISSION FORMATION AND CONTROL	(9)
Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.		
Unit-IV	ALTERNATIVE FUELS	(9)
Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.		
Unit-V	ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM	(9)
Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles – Fuel Cells.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.	
2	John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.	


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2	John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988.
3	V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.
4	John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988.
5	V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.

COURSE OUTCOMES:

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

CO1:	Explain the working of Gasoline fuel injection systems and SI combustion.
CO2:	Explain the working of Diesel fuel injection systems and CI combustion.
CO3:	Identify the source and measure it; explain the mechanism of emission formation and control methods.
CO4:	Select alternative fuel resources and its utilization techniques in IC engines.
CO5:	Explain advanced combustion modes and future power train 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	1	1	2	3	-	1	-	3	3	2	2
CO2	3	2	2	1	1	2	3	-	1	-	3	3	2	1
CO3	3	1	2	2	2	2	3	-	1	-	3	2	3	1
CO4	3	1	2	2	2	2	3	-	1	-	3	2	3	1
CO5	3	1	2	1	2	2	3	-	1	-	3	2	3	1
Avg.	3	1	1	1	2	2	2	-	1	-	3	2	3	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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2416	SOLAR VEHICLE TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To provide in-depth knowledge of solar energy fundamentals and their integration with electric mobility.					
	• To understand photovoltaic systems, maximum power extraction techniques, and their applications in transportation.					
	• To evaluate energy storage systems suitable for solar vehicles.					
	• To analyze drive trains, power electronics, and vehicle control systems.					
	• To simulate, design, and optimize solar-powered vehicles using modern tools.					

Unit-I	INTRODUCTION TO SOLAR VEHICLE TECHNOLOGY	(9)
Fundamentals of solar energy – solar constant, solar spectrum, insolation, solar geometry- Global and Indian scenario of solar energy use in transportation - Overview of conventional vs solar electric vehicles - Solar car architecture – types (solar-hybrid, solar-assisted EVs) - Role of green transportation in reducing emissions -Technical and economic feasibility of solar vehicles- Challenges and limitations: space constraints, weight, energy density• Government policies, incentives and case studies (India, Australia, Europe)		
Unit-II	PHOTOVOLTAIC TECHNOLOGY AND APPLICATIONS	(9)
Working principle of photovoltaic cells - Solar cell types: monocrystalline, polycrystalline, thin-film, organic, perovskite- Electrical characteristics of PV cells: IV curve, Fill factor, efficiency, degradation - Cell to module to array configurations – series/parallel interconnections - PV panel integration in vehicles – orientation, tilt, shading, cooling -Maximum Power Point Tracking (MPPT) techniques: Perturb & Observe, Incremental Conductance.		
Unit-III	ENERGY STORAGE SYSTEMS	(9)
Battery types and characteristics – battery management system – charging methods – hybrid energy storage (battery + supercapacitor) – thermal management of batteries.		
Unit-IV	DRIVE SYSTEMS AND POWER ELECTRONICS	(9)
DC-DC converters – motor controllers – inverter operation – drive cycles – regenerative braking – BLDC and PMSM motors used in solar vehicles.		
Unit-V	DESIGN AND SIMULATION	(9)
Vehicle layout – weight estimation – power budget calculation – simulation tools (MATLAB/Simulink, PVsyst) – case studies – prototype development.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	James P. Dunlop, Photovoltaic Systems, American Technical Publishers.	
2	Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.	


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REFERENCES:

1	John A. Duffie, William A. Beckman, Solar Engineering of Thermal Processes, Wiley.
2	Michael Boxwell, <i>Solar Electricity Handbook</i> , Greenstream Publishing.
3	Adrian Kitson, Solar Car: The Solar Race Car Manual, Speedy Publishing.

COURSE OUTCOMES:

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

CO1:	Understand the principles of solar energy and solar-powered transportation systems.
CO2:	Analyze photovoltaic cell technologies and solar panel configurations.
CO3:	Evaluate energy storage systems and management techniques for solar vehicles.
CO4:	Design and control electric drives and power systems for solar vehicles.
CO5:	Simulate and analyze solar vehicle performance using industry-standard 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	1	1	-	1	1	-	-	-	-	-	3	3
CO2	3	2	1	1	-	1	-	-	-	-	-	-	3	3
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	3
CO4	3	2	1	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	1	1	-	-	-	-	-	-	2	-	3	3
Avg.	3	2.8	1	1	-	0.4	0.2	-	-	-	2	-	3	3

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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2417	RENEWABLE ENERGY SOURCES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand and analyze the pattern of renewable energy resources. - To impart the knowledge and value of Solar Energy and Wind Energy. - To suggest methodologies or technologies for utilization of waste in energy. - To understand the economics of renewable energy sources, utilization and environmental aspects.					

Unit-I	NEED FOR RENEWABLE ENERGY	(9)
World energy usage -reserves for world energy resources. Principles of renewable energy – renewable energy resources and their importance. Conventional and non-conventional fuels. Review of possible renewable energy resources. Scientific principles, technical implications, and social implications. Environmental Aspects of Energy Utilization – Renewable Energy Scenario in Tamil Nadu, India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.		
Unit-II	SOLAR ENERGY	(9)
Solar radiation: Extra-terrestrial solar radiation - Measurement and estimation of solar radiation. Solar heating devices. Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications. Recent advancements in solar power generation. Photovoltaic Devices and Systems. Types and usage of photovoltaic systems. Grid connection; system design and RAPS (remote area power supply) applications.		
Unit-III	WIND ENERGY	(9)
Basics of Wind Energy. Current and Future Technologies - Benefits and Drawbacks of Wind Energy- Wind Turbine and its components- Loads on the wind turbine. Forces acting on-wind turbines and calculation of wind turbine efficiency. Process of electricity generation and supply to the grid (wind farms). Current and Potential Uses - Issues, Challenges, and Obstacles.		
Unit-IV	BIOMASS AND BIOENERGY	(9)
Biomass resources - Reviews the use of agricultural crops and solid biomass wastes in the production of Alternative fuels. Available Technologies for biomass energy production. Incineration, pyrolysis, gasification and other thermo-chemical processes. Ethanol and biogas production technologies. Recent advancements in Biomass energy production.		
Unit-V	OTHER RENEWABLE ENERGY RESOURCES	(9)
Introduction to Geothermal, Ocean thermal and tidal energies. Working principles of Geothermal, Ocean thermal and tidal power plants. Hydro Energy, Hydrogen Storage - Fuel Cell Systems – Hybrid Systems. Binary cycle power generation. Advantages and drawbacks. Current trends in geothermal, ocean thermal and tidal power technologies.		


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Total No of Periods to be Taught	45
TEXT BOOK:	
1	Rai, G.D. "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2017.
2	Twidell, J.W. & Weir, A., "Renewable Energy Resources", EFN Spon Ltd., UK, 2015.

REFERENCES:	
1	B.H. Khan, "Non-Conventional Energy Resources", The McGraw Hill companies, 2017.
2	Tiwari, G.N. "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2013.
3	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Know the importance of renewable energy sources utilization and various renewable energy technologies
CO2:	Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
CO3:	Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
CO4:	Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
CO5:	Acquire the knowledge of wave power, tidal power and geothermal principles and applications.

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	1	2	-	2	-	-	-	1	1	3	2	-
CO2	3	3	3	3	1	1	2	-	-	-	2	3	2	-
CO3	3	3	3	3	3	2	1	-	1	-	2	3	2	-
CO4	3	2	2	0	0	1	2	1	-	-	2	2	2	-
CO5	3	2	2	1	-	-	1	-	1	1	2	2	2	-
Avg.	3	2.5	2.4	2	1.4	2	2	1	1	1	2	2.6	2	-

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2418	REFRIGERATION AND AIR CONDITIONING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components. - To provide knowledge on design aspects of Refrigeration & Air conditioning systems. - To study the Vapour absorption and air refrigeration systems. - To learn the psychrometric properties and processes. - To study the air conditioning systems and load estimation.					

Unit-I	INTRODUCTION	(9)
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.		
Unit-II	VAPOUR COMPRESSION REFRIGERATION SYSTEM	(9)
Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.		
Unit-III	OTHER REFRIGERATION SYSTEMS	(9)
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic-Vortex and Pulse tube refrigeration systems.		
Unit-IV	PSYCHROMETRIC PROPERTIES AND PROCESSES	(9)
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.		
Unit-V	AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION	(9)
Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system;Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors,Actuators& Safety controls.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010	
2	Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi 10 February 2019	


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REFERENCES:

1	ASHRAE Hand book, Fundamentals, 2010
2	Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3	Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4	Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
5	A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput 1 January 2013

COURSE OUTCOMES:

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

CO1:	Explain the basic concepts of Refrigeration
CO2:	Explain the Vapor compression Refrigeration systems and to solve problems
CO3:	Discuss the various types of Refrigeration systems
CO4:	Calculate the Psychrometric properties and its use in psychrometric processes
CO5:	Explain the concepts of Air conditioning and to solve 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	2	1	1	1	-	-	2	-	1	-	1	2	2	1
CO2	2	1	1	1	-	-	2	-	1	-	1	2	2	1
CO3	2	1	1	1	-	-	2	-	1	-	1	2	2	1
CO4	2	1	1	1	-	-	2	-	1	-	1	2	2	1
CO5	2	1	1	1	-	-	2	-	1	-	1	2	2	1
Avg.	2	1	1	1	-	-	2	-	1	-	1	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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2419	GAS DYNAMICS AND JET PROPULSION	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To study the fundamentals of compressible flow concepts and the use of gas tables. - To learn the compressible flow behaviour in constant area ducts. - To study the development of shock waves and its effects. - To study the types of jet engines and their performance parameters. - To learn the types of rocket engines and their performance parameters.					

Unit-I	BASIC CONCEPTS AND ISENTROPIC FLOWS	(9)
Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.		
Unit-II	COMPRESSIBLE FLOW THROUGH DUCTS	(9)
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.		
Unit-III	NORMAL AND OBLIQUE SHOCKS	(9)
Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.		
Unit-IV	JET PROPULSION	(9)
Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.		
Unit-V	SPACE PROPULSION	(9)
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Anderson, J.D., “Modern Compressible flow”, Third Edition, McGraw Hill, 2003.	
2	S.M. Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 4th Edition, 2012.	


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REFERENCES:

1	R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011.
2	Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3	Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2006.
4	Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5	Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2008.

COURSE OUTCOMES:

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

CO1:	Apply the fundamentals of compressible flow concepts and the use of gas tables.
CO2:	Analyze the compressible flow behaviour in constant area ducts.
CO3:	Analyze the development of shock waves and its effects.
CO4:	Explain the types of jet engines and their performance parameters.
CO5:	Explain the types of rocket engines and their performance parameters.

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	2	1	1	-	-	-	-	1	-	1	3	1	2
CO2	3	2	1	1	-	-	-	-	1	-	1	3	1	2
CO3	3	2	1	1	-	-	-	-	1	-	1	3	1	2
CO4	2	2	1	1	-	-	-	-	1	-	1	3	1	2
CO5	2	2	1	1	-	-	-	-	1	-	1	3	1	2
Avg.	3	2	1	1	-	-	-	-	1	-	1	3	1	2

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2420	POWER PLANT TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To study the coal based thermal power plants. - To study the diesel, gas turbine and combined cycle power plants. - To learn the basic of nuclear engineering and power plants. - To learn the power from renewable energy - To study energy, economic and environmental issues of power plants.					

Unit-I	COAL BASED THERMAL POWER PLANTS	(9)
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.		
Unit-II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	(9)
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.		
Unit-III	NUCLEAR POWER PLANTS	(9)
Basics of nuclear engineering, Layout and subsystems of Nuclear power plants, Working of nuclear reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for nuclear power plants.		
Unit-IV	POWER FROM RENEWABLE ENERGY	(9)
Hydro Electric Power Plants – Classification, Typical Layout and associated components including turbines. Principle, construction and working of wind, tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		
Unit-V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	(9)
Power tariff types, Load distribution parameters, Load curve, Comparison of site selection criteria, relative merits and demerits, Capital and operating cost of different power plants. Pollution control technologies including waste disposal options for coal and nuclear power plants.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008	
2	R.K.Rajput, "A text book of Power Plant Engineering", Fifth Edition	


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REFERENCES:

1	El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd.,2010.
2	Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill,1998.
4	Power Plant Engineering by B. VijayaRamnath C. Elanchezhian, L. Saravanakumar 1 November 2019

COURSE OUTCOMES:

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

CO1:	Explain the layout, construction and working of the components inside a thermal power plant.
CO2:	Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
CO3:	Explain the layout, construction and working of the components inside nuclear power plants
CO4:	Explain the layout, construction and working of the components inside Renewable energy power plants
CO5:	Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

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	1	1	-	1	3	-	-	1	1	2	2	1
CO2	3	1	1	1	-	1	3	-	-	1	1	2	2	1
CO3	3	1	1	1	-	1	3	-	-	1	1	2	2	1
CO4	3	1	1	1	-	1	3	-	-	1	1	2	2	1
CO5	3	1	1	1	-	1	3	-	-	1	1	2	2	1
Avg.	3	1	1	1	-	1	3	-	-	1	1	2	2	1

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2421	ENERGY CONSERVATION & WASTE HEAT RECOVERY	L	T	P	C	100
		3	0	0	3	
Course Objectives	To learn quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign.					

Unit-I	INTRODUCTION	(9)
Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.		
Unit-II	ELECTRICAL SUPPLY SYSTEMS	(9)
Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics.		
Unit-III	ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES	(9)
Stoichiometry - Combustion principles. Energy conservation in: Boilers – Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.		
Unit-IV	ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS	(9)
Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems.		
Unit-V	FIRE AND EXPLOSION	(9)
Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept– PAT scheme.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at http://www.em-ea.org/gbook1.asp . This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.	
2	K. NagabhushanRaju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.	

REFERENCES:	
1	Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2	Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7 th Edition, The Fairmont Press, 2013.

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3	Murphy.W.R. and McKay.G, "Energy Management", Butterworth, London 1982.
4	Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy anagers, plant engineers, and designers, Pergamon Press, 1981.
5	Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

COURSE OUTCOMES:

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

CO1:	Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign.
CO2:	Analyse factors behind energy billing and apply the concept of demand sidemanagement for lowering energy costs.
CO3:	Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries.
CO4:	Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency.
CO5:	Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project.

Mapping of COs with POs and PSOs

COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	3	1	1	-	1	1	-	-	-	-	-	3	3
CO2	3	2	1	1	-	1	-	-	-	-	-	-	3	3
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	3
CO4	3	2	1	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	1	1	-	-	-	-	-	-	-	-	3	3
Avg.	3	2.8	1	1	-	0.4	0.2	-	-	-	-	-	3	3

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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2422	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To introduce Governing Equations of viscous fluid flows • To introduce numerical modeling and its role in the field of fluid flow and heat transfer • To enable the students to understand the various discretization methods, solution procedures and turbulence modeling. • To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.					

Unit-I	GOVERNING EQUATIONS AND BOUNDARY CONDITIONS	(9)
Basics of computational fluid dynamics–Governing equations of fluid dynamics–Continuity, Momentum and Energy equations–Chemical species transport–Physical boundary conditions Time-averaged equations for Turbulent Flow–Turbulent–Kinetic Energy Equations–Mathematical behavior of PDEs on CFD–Elliptic, Parabolic and Hyperbolic equations.		
Unit-II	FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION	(9)
Derivation of finite difference equations–Simple Methods–General Methods for first and second order accuracy–Finite volume formulation for steady state One, Two and Three dimensional diffusion problems–Parabolic equations–Explicit and Implicit schemes Example problems on elliptic and parabolic equations–Use of Finite Difference and Finite Volume methods.		
Unit-III	FINITE VOLUME METHOD FOR CONVECTION DIFFUSION	(9)
Steady one-dimensional convection and diffusion–Central, upwind differencing schemes properties of discretization schemes–Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.		
Unit-IV	FLOW FIELD ANALYSIS	(9)
Finite volume methods-Representation of the pressure gradient term and continuity equation–Staggered grid–Momentum equations–Pressure and Velocity corrections–Pressure Correction equation, SIMPLE algorithm and its variants–PISO Algorithms		
Unit-V	TURBULENCE MODELS AND MESH GENERATION	(9)
Turbulence models, mixing length model, Two equation (k-ε) models–High and low Reynolds number models–Structured Grid generation–Unstructured Grid generation–Mesh refinement–Adaptive mesh–Software tools.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.	
2	Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2007.	


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REFERENCES:

1	Anil W. Date "Introduction to Computational Fluid Dynamics "Cambridge University Press, 2005.
2	Chung, T.J."Computational Fluid Dynamics", Cambridge University, Press, 2002.
3	Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4	Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.
5	Patankar, S.V."Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004

COURSE OUTCOMES:

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

CO1:	Derive the governing equations and boundary conditions for Fluid dynamics
CO2:	Analyze Finite difference and Finite volume methods for Diffusion
CO3:	Analyze Finite volume method for Convective diffusion
CO4:	Analyze Flow field problems
CO5:	Explain and solve the Turbulence models and Mesh generation 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	3	2	1	1	-	-	-	-	1	-	-	3	1	2
CO2	3	2	1	1	-	-	-	-	1	-	-	3	1	2
CO3	3	2	1	1	-	-	-	-	1	-	-	3	1	2
CO4	2	2	1	1	-	-	-	-	1	-	-	3	1	2
CO5	2	2	1	1	-	-	-	-	1	-	-	3	1	2
Avg.	3	2	1	1	-	-	-	-	1	-	-	3	1	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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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2423	ENERGY STORAGE DEVICES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To study the various types of energy storage devices and technologies and them comparison. - To learn the techniques of various energy storage devices and their performances. - To learn the basics of batteries and hybrid systems for EVs and other mobile applications. - To learn about the renewable energy storage systems and management systems. - To have an insight into other energy storage devices, hydrogen, and fuel cells..					

Unit-I	INTRODUCTION TO ENERGY STORAGE	(9)
Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.		
Unit-II	ENERGY STORAGE SYSTEMS	(9)
Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types Charging and Discharging – Battery testing and performance.		
Unit-III	MOBILE AND HYBRID ENERGY STORAGE SYSTEMS	(9)
Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.		
Unit-IV	RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT	(9)
Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management.		
Unit-V	OTHER ENERGY DEVICES	(9)
Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2 nd Edition, Springer, 2015.	
2	Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001	


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REFERENCES:

1	Jane Bluent, Nigel & Balchin C., "Health and Safety in Welding and Allied Processes", 5th Edition, Wood Head Publishing, England, 2002
2	Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2002.
3	Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4	Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications", University Press (India), 2006
5	Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

COURSE OUTCOMES:

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

CO1:	Discuss the need and identify the suitable energy storage devices for applications.
CO2:	Explain the working of various energy storage devices and their importance.
CO3:	Explain the basic characteristics of batteries for mobile and hybrid systems.
CO4:	Discuss the storage of renewable energies and management systems.
CO5:	Explain the need for other energy devices and their scope for 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	2	1	1	1	-	2	-	-	-	-	1	2	3
CO2	3	2	1	1	1	-	2	-	-	-	-	1	2	3
CO3	3	2	1	1	1	-	2	-	-	-	-	1	2	3
CO4	3	2	1	1	1	-	2	-	-	-	-	1	2	3
CO5	3	2	1	1	1	-	2	-	-	-	-	1	2	3
Avg.	3	2	1	1	1	-	2	-	-	-	-	1	2	3

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – II Energy Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2424	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the significance of energy conservation and energy auditing in industrial sectors. - To analyze energy usage patterns and identify potential savings. - To study energy-efficient technologies in thermal and electrical systems. - To explore energy conservation in various industrial processes and utilities. - To introduce economic analysis of energy conservation measures.					

Unit-I	ENERGY SCENARIO AND ENERGY AUDIT	(9)
Global and Indian energy scenario – Sector-wise energy consumption – Energy conservation act and policies – Basics of energy audit – Types of audits – Audit methodology – Energy auditing instruments.		
Unit-II	THERMAL UTILITIES AND ENERGY CONSERVATION	(9)
Boilers – Furnaces – Heat exchangers – Insulation – Steam systems – Cooling towers – Combustion systems – Energy conservation measures – Performance assessment.		
Unit-III	ELECTRICAL SYSTEMS AND ENERGY CONSERVATION	(9)
Electric motors – Drives – Lighting systems – HVAC – Compressors – Pumps and fans – Power factor improvement – Energy-efficient equipment – Harmonics – Demand side management.		
Unit-IV	PROCESS INDUSTRIES AND ENERGY CONSERVATION	(9)
Energy conservation in process industries: textile, cement, sugar, paper, iron & steel, food processing – Industry-specific case studies – Cogeneration and waste heat recovery.		
Unit-V	ECONOMIC ANALYSIS OF ENERGY CONSERVATION	(9)
Life cycle costing – Payback period – Net present value – Internal rate of return – Cost-benefit analysis – Financial appraisal – Case studies and energy project evaluation.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Mistry. K.U “Fundamentals of Industrial safety and health”, 2nd Edition, SiddharthPrakashan Publisher,Gujarat,2009.	


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REFERENCES:

1	Jane Bluent, Nigel & Balchin C., "Health and Safety in Welding and Allied Processes", 5th Edition, Wood Head Publishing, England, 2002
2	Rao S, Jain R.K. & Saluja H.L., "Electrical Safety - Fire Safety Engineering and Safety Management", 2nd Edition, Khanna Publishers, Delhi, 1997.
3	Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016
4	Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
5	Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK, 2nd Edition 1990 .

COURSE OUTCOMES:

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

CO1:	Understand national and global energy consumption patterns and the need for energy conservation.
CO2:	Conduct energy audits in industrial setups and identify opportunities for energy saving.
CO3:	Analyze thermal systems and apply energy conservation techniques.
CO4:	Improve electrical system efficiency using modern technologies and controls.
CO5:	Evaluate techno-economic feasibility of energy conservation projects using financial tools.

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	2	1	1	-	1	1	-	-	-	-	-	3	1
CO2	3	3	1	1	-	1	-	-	-	-	-	-	3	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	1
CO4	3	3	1	1	-	-	-	-	-	-	-	-	3	1
CO5	2	3	1	1	-	-	-	-	-	-	-	-	3	1
Avg.	2.8	2.6	1	1	-	0.4	0.2	-	-	-	-	-	3	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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2425	NON TRADITIONAL MACHINING TECHNIQUES	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To impart knowledge in the field of non-traditional machining techniques and describe mechanical, chemical, electrochemical and thermo-electric energy based non-Traditional machining techniques. - To gain knowledge on Nano Finishing and hybrid nontraditional techniques					

Unit-I	INTRODUCTION AND MECHANICAL ENERGY BASED TECHNIQUES	(9)
Introduction - Need for non-traditional machining techniques - Classification of non-traditional machining techniques - Applications, advantages and limitations of non-traditional machining techniques - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.		
Unit-II	CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED TECHNIQUES	(9)
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electrochemicaldeburring.		
Unit-III	THERMO-ELECTRIC ENERGY BASED TECHNIQUES	(9)
Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.		
Unit-IV	NANO FINISHING TECHNIQUES	(9)
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnet-orheological finishing, Magneto rheological abrasive flow finishing.		
Unit-V	HYBRID NON-TRADITIONAL MACHINING TECHNIQUES	(9)
Introduction-Various hybrid non-traditional machining techniques, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non- traditional machining techniques.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13:9788126910458	
2	Anand Pandey, "Modern Machining Processes",Ane Books Pvt. Ltd., New Delhi, India,2019.	

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1	Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13:978-0824773526.
2	Carl Sommer, "Non-Traditional Machining Hand book", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3	Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4	Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13:978-3319259208.

COURSE OUTCOMES:

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

CO1:	Students can able to formulate different types of non-traditional machining techniques and evaluate mechanical energy based non-traditional machining techniques.
CO2:	Students are able to demonstrate chemical and electrochemical energy-based processes.
CO3:	Thermoelectric energy-based approaches can be evaluated by students.
CO4:	Students are capable of deciphering nano-finishing methods.
CO5:	Gain knowledge on hybrid non-traditional machining processes and differentiate non-traditional machining techniques.

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	-	1	-	1	-	1	-	1	1	1	2	2	2
CO2	3	-	1	-	1	-	1	-	1	1	1	2	2	2
CO3	3	-	1	-	1	-	1	-	1	1	1	2	2	2
CO4	3	-	2	-	1	-	1	-	1	1	1	2	2	2
CO5	3	-	3	-	3	-	1	-	1	1	1	3	3	3
Avg.	3	-	1	-	1	-	1	-	1	1	1	2	2	2

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2426	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.		


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Total No of Periods to be Taught	30
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, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2	Barry Hull and Vernon John, "Nondestructive Testing", Macmillan, 1989.
3	Chuck Hellier, "Handbook of Nondestructive Evaluation", McGraw Hill, 2012.
4	Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

List of Exercises/Experiments	
1.	Conducting experiment using liquid penetrant testing.
2.	Conducting experiment using magnetic particle testing.
3.	Conducting experiment using ultrasonic testing.
4.	Conducting experiment using electromagnetic testing.
5.	Conducting experiment using acoustic emission testing.
6.	Conducting experiment using radiographic testing.
7.	Conducting experiment for ultrasonic thickness measurement.
8.	Conducting experiment using visual inspection testing.
9.	Conducting experiment for leak detection testing.
10.	Conducting experiment using infrared thermography testing.
Total No of Periods to be Taught	30

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.


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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.N O	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Liquid Penetrant Testing Kit	3
2.	Magnetic Particle Testing Kit	3
3.	Ultrasonic Flaw Detector	3
4.	Ultrasonic Thickness Gauge	3
5.	Eddy Current Testing Equipment	3
6.	Acoustic Emission Testing Setup	1
7.	Radiographic Testing Unit	1
8.	Infrared Thermography Camera	1
9.	Leak Detection Test Setup	2
10.	Visual Inspection Kit	3
11.	UV Lamp	3
12.	Calibration Blocks	3
13.	Computer System with NDT Software	5
14.	Safety Equipment (PPE)	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	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

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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2427	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, MahyarKhorasani "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:

3.	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
4.	Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
5.	Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
6.	Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
7.	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	

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.


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CO5:	Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.
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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.N O	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1.	Extrusion Based 3D Printer (FDM)	3 Nos
2.	Resin Based 3D Printer (SLA/DLP)	2 Nos
3.	CAD Workstations	15 Nos
4.	Mechanical Design Software (SolidWorks/CATIA/Fusion 360)	15 Licenses
5.	STL Editing and Slicing Software	15 Licenses
6.	Topology Optimization Software	5 Licenses
7.	Filament Materials (PLA/ABS/PETG)	As Required
8.	Photopolymer Resin	As Required
9.	STL File Repair Software	15 Licenses
10.	Post Processing Tool Kit	3 Sets
11.	UV Curing Station	1 No
12.	Vernier Caliper	10 Nos
13.	Safety Equipment (Gloves, Goggles, Mask)	30 Sets

Mapping of COs with POs and PSOs														
COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
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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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2428	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C	100
		3	0	0	3	
Course Objectives	To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.					

Unit-I	INTRODUCTION	(9)
Brief introduction to CAD and CAM– Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM– Concurrent Engineering-CIM concepts– Computerised elements of CIM system Types of production- Manufacturing models and Metrics– Mathematical models of Production Performance– Simple problems– Manufacturing Control– Simple Problems– Basic Elements of an Automated system– Levels of Automation– Lean Production and Just-In-Time Production.		
Unit-II	PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING	(9)
Process planning– Computer Aided Process Planning (CAPP)– Logical steps in Computer Aided Process Planning– Aggregate Production Planning and the Master Production Schedule– Material Requirement planning– Capacity Planning- Control Systems-Shop Floor Control-Inventory Control– Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP)- Simple Problems.		
Unit-III	CELLULAR MANUFACTURING	(9)
Group Technology(GT), Part Families– Parts Classification and coding– Simple Problems in Opitz Part Coding system– Production flow Analysis– Cellular Manufacturing– Composite part concept– Machine cell design and layout– Quantitative analysis in Cellular Manufacturing– Rank Order Clustering Method- Arranging Machines in a GT cell– Hollier Method– Simple Problems.		
Unit-IV	FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)	(9)
Types of Flexibility- FMS– FMS Components– FMS Application & Benefits– FMS Planning and Control– Quantitative analysis in FMS– Simple Problems. Automated Guided Vehicle System (AGVS)– AGVS Application– Vehicle Guidance technology– Vehicle Management & Safety.		
Unit-V	INDUSTRIAL ROBOTICS	(9)
Robot Anatomy and Related Attributes– Classification of Robots- Robot Control systems– End Effectors– Sensors in Robotics– Robot Accuracy and Repeatability- Industrial Robot Applications– Robot Part Programming– Robot Accuracy and Repeatability– Simple Problems.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.	
2	Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.	


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REFERENCES:

1	Gideon Halevi and Roland Weill, "Principles of Process Planning– A Logical Approach" Chapman & Hall, London, 1995.
2	Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.
3	Rao. P, N Tewari&T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

COURSE OUTCOMES:

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

CO1:	Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems
CO2:	Summarize the production planning and control and computerized process planning
CO3:	Differentiate the different coding systems used in group technology
CO4:	Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system
CO5:	Classification of robots used in 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	2	2	2	2	-	-	-	1	-	1	2	1	3
CO2	3	2	2	2	2	-	-	-	1	-	1	2	1	3
CO3	3	2	2	2	2	-	-	-	1	-	1	2	1	3
CO4	3	2	2	2	2	-	-	-	1	-	1	2	1	3
CO5	3	2	2	2	2	-	-	-	1	-	1	2	1	3
Avg.	3	2	2	2	2	-	-	-	1	-	1	2	1	3

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


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Department	Mechanical	Programme Code & Name			114-Mechanical		
Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UMEPE2429	COMPUTER INTEGRATED MANUFACTURING SYSTEMS		L	T	P	C	100
			3	0	0	3	
Course Objectives	To understand the various destructive and non-destructive testing methods of materials and its industrial applications.						

Unit-I	INTRODUCTION TO MATERIALS TESTING	(9)
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.		
Unit-II	MECHANICAL TESTING	(9)
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.		
Unit-III	NON DESTRUCTIVE TESTING	(9)
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.		
Unit-IV	MATERIAL CHARACTERIZATION TESTING	(9)
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.		
Unit-V	OTHER TESTING	(9)
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermomechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.	
2	Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.	
3	P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007	

REFERENCES:


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1	Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2	ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA
3	Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

COURSE OUTCOMES:

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

CO1:	Identify suitable testing standards for conducting destructive and non-destructive testings
CO2:	Identify suitable destructive testings for identifying the properties of materials
CO3:	Identify suitable Non-destructive testings for identifying defects in a material as per industrial standards.
CO4:	Identify suitable characterization technique for identifying internal defects in a material
CO5:	Ability to use the different technique and know its applications and limitations

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	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	3	2	2		-	-	-	-	-	2	-	-	-
CO4	3	3	3	3	2	-	-	-	-	-	2	-	-	-
CO5	3	3	3	3	3	-	-	-	-	1	2	-	-	-
Avg.	3	2.6	1.4	1.6	1	-	-	-	-	0.2	1.6	-	-	-

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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2430	PRODUCTIVITY AND REENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To understand the basic concepts of productivity • To Measure and evaluate productivity • To Plan and implement various productivity techniques. • To apply the concepts of Reengineer the process for improving the productivity • To analyse BPR tools for improving the productivity.					

Unit-I	INTRODUCTION TO MATERIALS TESTING	(9)
Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management.		
Unit-II	PRODUCTIVITY MEASUREMENT AND EVALUATION	(9)
Productivity measurement in International, National and Industrial level – Total Productivity Model – Productivity measurement in Manufacturing and Service sectors – Performance Objective Productivity (POP) model – Need for Productivity Evaluation – Evaluation Methodology.		
Unit-III	PRODUCTIVITY PLANNING AND IMPLEMENTATION	(9)
Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.		
Unit-IV	REENGINEERING PROCESS	(9)
Definition, Fundamentals of process reengineering – Principles, Methodology and guidelines for Organization Transformation, DSMCQ and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models.		
Unit-V	BPR TOOLS AND IMPLEMENTATION	(9)
Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Sumanth, D.J, "Productivity Engineering and Management", TMH, New Delhi, 1990	
2	Sudit, Ephraim F., "Productivity Based Management", Springer 1984	

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REFERENCES:

1	Edosomwan, J.A, "Organizational Transformation and Process re- Engineering", British Cataloging in publications,1996.
2	Premvrat, Sardana, G.D. and Sahay, B.S, "Productivity Management - A systems approach", Narosa Publications, New Delhi, 1998.
3	Rotini, Federico, Borgianni, Yuri, Cascini, Gaetano, "How to Achieve Global Success in the Changing Marketplace", Springer 2012.

COURSE OUTCOMES:

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

CO1:	Understanding the basic concepts of productivity.
CO2:	Measure and evaluate productivity.
CO3:	Plan and implement various productivity techniques.
CO4:	Reengineer the process for improving the productivity
CO5:	Implement BPR tools for improving the productivity

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	-	-
CO2	2	2	-	2	-	-	-	-	2	-	2	-	-	-
CO3	3	3	2	1	-	-	-	1	-	-	2	1	-	-
CO4	2	3	-	2	2	2	2	3	2	2	2	3	-	2
CO5	3	1	2	3	3			3	3	3	1	-	-	3
Avg.	2.4	2.25	2	2	2.5	2	2	2	2.33	2.5	1.6	2	-	2.5

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2431	MATERIALS CHARACTERIZATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Understanding the various techniques of structural characterization of materials. • Interpreting the microstructure, crystal structure and surface structure of materials on X-Ray diffraction techniques and analysis • To import knowledge on different electron microscopy techniques used for characterization • To import knowledge on different electron microscopy techniques used for characterization • To import knowledge on techniques of elemental chemical composition and structure of surface.					

Unit-I	METALLOGRAPHIC TECHNIQUES	(9)
Macro examination -applications, metallurgical microscope - construction and principle of working, specimen preparation, light material interaction – Rayleigh Scattering, Abbes theory; magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources; lenses aberrations and their remedial measures, Principles of microscopy -bright field , dark field, phase contrast, polarization, differential interference contrast, high temperature microscopy; Quantitative metallography – Image analysis for grain size distribution and grain/precipitate shape.		
Unit-II	X-RAY DIFFRACTION TECHNIQUES	(9)
Reciprocal lattice, Stereographic projection, X-ray generation, absorption edges, characteristic and continuous spectrum, Bragg's law, Ewald's Sphere, Diffraction methods – Laue, rotating crystal and powder methods. Intensity of diffracted beams –structure factor calculations and other factors. Diffractometer – General features and optics, Counters - Proportional, Scintillating, Geiger counters and semiconductor based.		
Unit-III	ANALYSIS OF X-RAY DIFFRACTION	(9)
Line broadening-crystallite size, residual stress; Texture Analysis; Crystal structure determination indexing -Phase identification- ASTM catalogue of Materials identification, quantitative phase estimation, Phase diagram determination, Precise lattice parameter calculation, Determination of residual stress – double angle diffraction.		
Unit-IV	ELECTRON MICROSCOPY	(9)
Electron specimen interaction; Construction and operation of Transmission electron microscope (TEM) – specimen preparation techniques- Diffraction mode and image mode, Sources of contrast- Selected Area Electron Diffraction, Zone axis, indexing ; Construction, modes of operation and sources of contrast of Scanning electron microscope(SEM), Electron probe micro analysis, Basics of Field ion microscopy (FIB), Scanning Tunnelling Microscope (STM) and Atomic Force Microscope(AFM).		
Unit-V	SURFACE ANALYSIS	(9)
X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy- Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry - Quadrupole mass spectrometer ; Surface Structure -Unit meshes of five types of surface nets - diffraction from diaperiodic structures - Low Energy Electron Diffraction (LEED)- Reflection High Energy Electron Diffraction (RHEED).		

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Total No of Periods to be Taught	45
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TEXT BOOK:

1	Angelo, P.C., "Materials Characterisation", 1st Edition Cengage Publication, 2016.
2	Cullity, B. D., Stock, S.R. "Elements of X-ray diffraction", Pearson New International Edition, 3rd Edition, 2014

REFERENCES:

1	Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
2	D. A. Skoog, F. James Leary and T. A. Nieman, "Principles of Instrumental Analysis", 7th edition, Cengage Learning, 2017.
3	Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
4	Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation ", Ninth Edition, ASM international, USA, 1986.
5	Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University of Science and Technology, John Wiley & Sons (Asia) Pte Ltd. 2010.

COURSE OUTCOMES:

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

CO1:	Describe the principle of metallography and its application.
CO2:	Explain the principle of XRD and its scope for metallurgical analysis..
CO3:	Interpret and analyse the XRD results.
CO4:	Discuss the various techniques of electron microscopy and their applications.
CO5:	Describe the different techniques for the analysis of elemental chemical composition and structure of surface.

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	2	3	2	2	-	1	-	-	-	2	3	3	1
CO2	3	2	3	2	2	-	1	-	-	-	2	3	3	1
CO3	3	3	3	3	2	-	-	-	-	-	2	3	3	-
CO4	3	3	3	3	2	-	-	-	-	-	2	3	3	-
CO5	3	3	3	3	2	-	-	-	-	-	2	3	3	-
Avg.	3	3	3	3	2	-	1	-	-	-	2	3	3	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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2432	POLYMER MATERIALS AND THEIR PROCESSING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To understand the science and technology of Polymer synthesis. • To study Mechanical and Degradation behavior of Polymeric materials. • To select a suitable manufacturing technique for the production of Polymers. • To select polymers for domestic as well as industrial appliances.					

Unit-I	INTRODUCTION TO POLYMERS	(9)
Basic Concept, Raw Materials for Polymers, Polymerization principles and processes (step, chain and other polymerizations, polymer kinetics), Polymerization techniques, Polymer manufacture (unit operations, polymer reactors, polymer isolation, handling and storage), polymer structure and property		
Unit-II	POYMER MOLECULAR WEIGHT DETERMINATION, CHARACTERIZATION AND MODIFICATION	(9)
Number average and weight average molecular weights – Degree of polymerization – Molecular weight distribution – Polydispersity – Molecular weight determination-Methods – viscometry - Gel Permetation Chromatography. Polymer Characterization and Polymer Modification.		
Unit-III	MECHANICAL AND DEGRADATION BEHAVIOUR OF POLYMERS	(9)
First and second order transitions – Glass transition, Tg– multiple transitions in polymers – experimental study – significance of transition temperatures. Crystallinity in polymers – effect of crystallization – factors affecting crystallization, crystal nucleation and growth – Relationship between Tg and Tm – Structure–Property relationship. Viscoelasticity-creep and stress relaxation in polymers. Yielding and fracture of polymers, crazing of polymers. Degradation mechanisms – thermal, mechanical and photo degradations,		
Unit-IV	PROCESSING AND TESTING OF POLYMERS	(9)
Overview of Features of Single screw extruder –Tubular blown film process - Coextrusion.-Injection Mouldingprocess – Compression & Transfer Moulding - Blow Moulding – Rotational Moulding – Thermoforming – Vacuum forming Calendering process – Fiber Spinning process –Structural Foam Moulding/ Foaming - Sandwich Moulding. - Reaction Injection Moulding& Reinforced Reaction Injection Moulding, Polymer compounding and fabrication (polymer additives, Compounding processes, fabrication techniques, post fabrication operations) Polymer testing (sample preparation, testing standards and methods, analysis of polymer and additives).		
Unit-V	APPLICATIONS OF POLYMERS	(9)
Polymer applications: Biodegradable polymers, Biomedical polymers, Conducting polymers, Engineering Plastics, High performance polymers, Polymer Assisted Abrasive Finishing process for Mechanical and Medical Components, Multicomponent polymeric materials (polymer miscibility, polymer blends and alloys, filled plastics, polymer composites).		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Gowariker V R, Viswanathan N V and JayadevSreedhar, "PolymerScience", New Age International P Ltd., 2005.
2	Bahadur and Sastry, "Principles of Polymer Science", NarosaPublishingHouse, 2002

REFERENCES:

1	Billmayer Jr. and Fred. W., "Textbook of Polymer Science", WileyTappers,1965
2	Crawford R.J, Plastics Engineering (3rd Ed), Pergamon Press, London(1987)
3	Fried J. R., "Polymer Science and Technology", Prentice Hall,1995.
4	Gowariker, "Polymer Science", Johan Wiley and Sons,1986.
5	Griskey G., "Polymer Process Engineering", Chapman & Hall, NewYork,1995.

COURSE OUTCOMES:

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

CO1:	Understand the basics concepts and fundamental principles of Polymers and Polymerization.
CO2:	Evaluate the molecular weights of polymers and Characterize them.
CO3:	Understand the Mechanical and Degradation behaviour of Polymers.
CO4:	Identify suitable Polymer processing methods for Polymer products.
CO5:	Acquire the knowledge on Applications of Polymer

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	1	1	1	-	-	-	-	2	2	2	-
CO2	2	2	2	1	1	1	-	-	-	-	2	2	2	-
CO3	2	2	2	1	1	1	-	-	-	-	2	2	2	-
CO4	2	2	2	2	1	1	-	-	-	1	2	2	2	-
CO5	2	2	2	2	1	1	-	-	-	1	2	2	2	-
Avg.	2	2	2	2	1	1	-	-	-	1	2	2	2	-

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

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Department	Mechanical	Programme Code & Name			114-Mechanical		
Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UMEPE2433	MECHANICAL BEHAVIOUR OF MATERIALS		L	T	P	C	100
			3	0	0	3	
Course Objectives	• Having an overview of elastic and plastic behaviour of materials. • Getting enlightened with the different strengthening mechanisms. • Obtaining an insight into the types of fracture and mechanics of fracture. • Interpreting the fatigue behaviour of materials. • Having an insight on the high temperature behaviour of materials.						

Unit-I	ELASTIC AND PLASTIC BEHAVIOUR	(9)
Elastic behaviour of materials - Hooke's law, plastic behaviour: dislocation theory, Types of dislocations- Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning. Methods of observing dislocations		
Unit-II	STRENGTHENING MECHANISMS	(9)
Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fibre strengthening, Yield point phenomenon, strain aging and dynamic strain aging		
Unit-III	FRACTURE AND FRACTURE MECHANICS	(9)
Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.		
Unit-IV	FATIGUE BEHAVIOUR AND TESTING	(9)
Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage- Miner law, HCF / LCF, creep- fatigue interactions, micro mechanisms of fatigue crack initiation and growth, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture.		
Unit-V	CREEP BEHAVIOUR AND TESTING	(9)
Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Super plasticity.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Dieter, G. E., "Mechanical Metallurgy", McGraw-Hill Co., SI Edition, 1995
2	Thomas H. Courtney, "Mechanical Behaviour of Materials", Waveland Press, 2nd edition, 2005

REFERENCES:

1	Bhargava A K & Sharma C P, "Mechanical behaviour and Testing of materials" PHI learning 2011.
2	Norman E Dowling, "Mechanical Behaviour of Materials, Pearson 2013.
3	Prashant Kumar, "Elements of Fracture Mechanics", McGraw-Hill, 2009.
4	Shetty M N, Dislocations and mechanical behaviour of materials", PHI learning 2013.

COURSE OUTCOMES:

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

CO1:	Identify the role of dislocations and the mechanisms of plastic deformation.
CO2:	Explain the strengthening mechanisms of polycrystalline and composite materials.
CO3:	Analyse the nature of fracture and its underlying mechanism
CO4:	Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
CO5:	Assess the behaviour of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

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	3	-	-
CO2	3	-	2	-	-	2	-	-	-	-	1	3	-	-
CO3	3	2	3	3	-	-	-	-	-	-	1	3	2	-
CO4	2	3	2	-	-	-	1	-	-	-	1	3	2	-
CO5	3	2	2	3	-	-	1	-	-	-	1	3	2	2
Avg.	2.8	2.5	2.2	3	-	2	1	-	-	-	1	3	2	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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2434	INDUSTRY 4.0	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the concepts, technologies, and challenges of Industry 4.0. - Learn IoT, IIoT, smart devices, logistics, and predictive analytics applications. - Analyze Cyber-Physical Systems, automation, robotics, and cybersecurity in smart factories. - Understand the role of data, cloud computing, and digital transformation in Industry 4.0. - Study Industry 4.0 applications, future skills, and Society 5.0 concepts.					

Unit-I	INTRODUCTION TO INDUSTRY 4.0	(9)
Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.		
Unit-II	ROAD TO INDUSTRY 4.0	(9)
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities Predictive Analytics		
Unit-III	CYBER-PHYSICAL SYSTEMS AND AUTOMATION IN INDUSTRY 4.0	(9)
System, Technologies for enabling Industry 4.0–Cyber Physical Systems - Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Cyber Security		
Unit-IV	CLOUD TECHNOLOGIES IN INDUSTRY 4.0	(9)
Role of data, information, knowledge and collaboration in future organizations - Resource- based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics -Cloud Computing and Industry 4.0		
Unit-V	INDUSTRY 4.0 AND SOCIETY 5.0	(9)
Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0		
Total No of Periods to be Taught		45

TEXT BOOK:	
1	Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things
2	ArsheepBahga, Internet of Things: A Hands-On Approach

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1	Bhargava A K & Sharma C P, "Mechanical behaviour and Testing of materials" PHI learning 2011.
2	Norman E Dowling, "Mechanical Behaviour of Materials, Pearson 2013.
3	Prashant Kumar, "Elements of Fracture Mechanics", McGraw-Hill, 2009.
4	Shetty M N, Dislocations and mechanical behaviour of materials", PHI learning 2013.

COURSE OUTCOMES:

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

CO1:	Understand the evolution of industrial revolutions and explain the role of digitalization, big data, and predictive analytics in enabling smart factories.
CO2:	Analyze the technological roadmap to Industry 4.0, including IoT, IIoT, Internet of Services, and smart systems like manufacturing, logistics, and cities.
CO3:	Examine the role of cyber-physical systems, robotic automation, and mobile computing in Industry 4.0 environments, and evaluate cybersecurity challenges.
CO4:	Explain and apply the principles of knowledge sharing, cloud computing, and data as a resource in future digital organization within the Industry 4.0 framework.
CO5:	Evaluate Industry 4.0 case studies and assess the future of work, emerging skill needs, competitive strategies, and the societal impact through the lens of Society 5.0.

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	0	0	1	2	-	-	-	-	1	3	3	0
CO2	3	3	0	0	2	1	-	-	-	-	1	3	3	0
CO3	1	3	0	2	3	2	-	-	-	-	1	1	3	0
CO4	3	0	2	0	3	0	-	-	-	-	2	3	0	2
CO5	0	3	0	0	0	3	-	-	-	-	2	0	3	0
Avg.	2.5	3	2	2	2.2	2	-	-	-	-	1.4	2.5	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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2435	PRECISION MANUFACTURING	L	T	P	C	100
		3	0	0	3	
Course Objectives	To acquire knowledge on various precision machining techniques and the design aspects of precision machine tools					

Unit-I	PRECISION ENGINEERING	(9)
Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra- precision Processes and Nanotechnology.		
Unit-II	PRECISION MACHINING	(9)
Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro- turning, micro-milling, micro-drilling, micro-grinding, Ultra-precision diamond turning, Non- conventional micro machining techniques –abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electrochemical micro machining, laser beam micro machining, Electron beam micro machining, Focused Ion Beam micromachining, Fabrication of optical components by ultra precision finishing, Secondary finishing of AM parts – Need, Challenges and Processes.		
Unit-III	MACHINE DESIGN FOR PRECISION MANUFACTURING	(9)
Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application.		
Unit-IV	MECHANICAL AND THERMAL ERRORS	(9)
Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery, Error mapping and error budgets.		
Unit-V	MEASUREMENT AND CHARACTERISATION	(9)
Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laserscanners, White-Light Interference 3D Microscopes, Focus variation based Optical Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometer, Confocal laser scanning microscopy, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography, ISO standards for 3D surface Metrology.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Jain, V.K., Introduction to micromachining, Narosa publishers, 2018
2	Venkatesh V.C., Sudin Izman, Precision Engineering, Tata Mc. Graw Hill Publishing Company, New Delhi 2007.

REFERENCES:

1	David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2	Jain, V.K., Micromanufacturing Processes, CRC Press, 2012.
3	Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002
4	Kevin Harding, "Hand book of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
5	Murty, R. L., Precision Engineering in Manufacturing, New Age publishers, 2005.

COURSE OUTCOMES:

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

CO1:	Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.
CO2:	Explain the principle and working of different methods of precision machining.
CO3:	Explain the special construction requirements of precision machine tools.
CO4:	Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.
CO5:	Select a suitable measurement solution to measure and characterize precision machined features.

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	-	-
CO2	3	2	2	3	3	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	-
Avg.	3	2.6	2	3	3	-	-	-	-	-	-	3	3	-

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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Professional Electives - (Stream – III Advanced Materials and Manufacturing Systems)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2436	MATERIALS HANDLING & SOLID PROCESSING	L	T	P	C	100
		3	0	0	3	
Course Objectives	The main objective of the course is to prepare the students for understanding and applying the principles of material handling and solid processing equipment in industries.					

Unit-I	INTRODUCTION & PRINCIPLES OF MATERIAL HANDLING	(9)
Materials Handling: Definition – Scope – Importance – Characteristics - Classification of Materials – Twenty Principles of Materials Handling – Unit Load Concept – Definition of Unit Load – Advantages and Disadvantages – Load Unitization Process and Handling Methods – Pallets, Skids and Containers – Classification of Materials Handling Equipment – Basic Equipment Types – Classification of Handling Equipment.		
Unit-II	INDUSTRIAL VEHICLES/TRUCKS	(9)
Hand Trucks – Power Trucks – Fork Lift Trucks – Tractors.		
Unit-III	CONVEYORS	(9)
Belt Conveyors – Chain Conveyors – Haulage Conveyors – Cable Conveyors – Bucket Conveyors – Roller Conveyors – Screw Conveyors – Pneumatic Conveyors – Hydraulic Conveyors.		
Unit-IV	HOISTING EQUIPMENT	(9)
Parts of Hoisting Equipment – Hoists – Winches – Elevators – Cranes – Derricks.		
Unit-V	SOLID (BULK) HANDLING EQUIPMENT	(9)
Storage of Bulk Solids – Bulk Handling Equipment – Robotic Handling – Materials Handling at the Workplace – Robots and their Classification – Robotic Handling Applications - Auxiliary Equipment – Gates – Feeders – Chutes – Positioners – Ball Table – Pallet Loader and Un-loader.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Siddhartha Ray, Introduction to Materials Handling, New Age International Pub., 2008.
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REFERENCES:

1	Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981
2	Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958
3	Norton. L Robert. "Machine Design – An Integrated Approach" Pearson Education, 2 nd Ed. 2005.
4	Rudenko, N., Materials Handling Equipment, ELnvee Publishers, 1970.
5	Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.

COURSE OUTCOMES:

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

CO1:	Apply the principles of material handling equipment in industries.
CO2:	Apply the principles of industrial vehicles / trucks in industries.
CO3:	Apply the principles of conveyer in industries.
CO4:	Apply the principles of hoisting equipment in industries
CO5:	Apply the principles of solid (bulk) handling equipment in 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	3	2	3	1	-	-	-	-	1	-	1	2	3	1
CO2	3	2	3	1	-	-	-	-	1	-	1	2	3	1
CO3	3	2	3	1	-	-	-	-	1	-	1	2	3	1
CO4	3	2	3	1	-	-	-	-	1	-	1	2	3	1
CO5	3	2	3	1	-	-	3	3	1	-	1	2	3	1
Avg.	3	2	3	1	-	-	3	3	1	-	1	2	3	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2437	INDUSTRIAL ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To impart knowledge in the field work study ,method study and work measurement in an industry - To gain knowledge on plant layout and material handling equipment used in the industries. - Gain knowledge for executing the project plan and production planning and control for improving the efficiency of productivity - To impart knowledge on different management system and forecasting techniques					

Unit-I	WORK SYSTEM DESIGN AND WORKSTUDY	(9)
Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, Techniques of Work Study, Human Aspects of Work Study. Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts-Examples. Motion Study: Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts. Memo-Motion Study, Cycle graph and Chmo-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods. Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Time Study Equipment, Performance Rating. Performance Rating: Examples, Allowances, Computation of Standard Time, Numerical on Computation of Standard Time, Case Study		
Unit-II	PLANT LAYOUT AND MATERIAL HANDLING	(9)
Plant Layout: Factors affecting location decisions, Facilities Requirement- Location and layout-Need for a layout study - Objectives and Features of a good Layout-Factors influencing layout - Classification-product, process, cellular and fixed position layouts Concepts and Designing for Process layout: CRAFT, ALDEP, CORELAP – Trends in computerized layout,Algorithms and models for Group Technology- ROC and Bond Energy Algorithms. Line balancing for Product Layout: Objectives, Line balancing techniques– Largest Candidate rule- Kilbridge and Wester method- RPW method- COMSOAL. Material Handling: Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept, Classification of material handling equipments, Equipment selection, Packaging		
Unit-III	PROJECT PLANNING AND CONCURRENT ENGINEERING	(9)
Project Management, Concepts and Definitions, Project Management Cycle, Risk associated with Projects Decision, Tree Modeling, Cost Evaluation Techniques in Project Management, GANTT Chart and Precedence Diagrams, PERT, CPM, Project Life Cycles, GERT, Q-GERT, Critical Chain and Theory of Constraints, Activity Network Diagram; Resource requirement, Resource constraints, Crashing of Jobs, Project Control Techniques, Earned Value Project Concurrent Engineering: Introduction, Components of C E models, Types of CE organizations		


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Unit-IV	PRODUCTION, PLANNING AND CONTROL	(9)
Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control, Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning(ERP) Scheduling: Types, functions and objectives, Sequencing n jobs on one machine–Schedule using Priority dispatch rules(FCFS,SPT,EDD,LCFS,and Critical Ratio). Sequencing ‘n’ jobs in Flow shop – Johnson, CDS and Palmer Algorithms.Sequencing ‘n’ jobs in Job shop–Two job son M machines		
Unit-V	INVENTORY CONTROL AND FORECASTING TECHNIQUES	(9)
Inventory Control: Introduction to Inventory and Materials Management, Inventory Problems and Selective Inventory Management, Determination of Economic order quantity and economic lot size, Static and Inventory Problems under Risk and Uncertainty, Two bin system - Ordering cycle system-ABC analysis Forecasting Techniques: Introduction, Demand patterns, Factors affecting demand, Subjective forecasting methods, Casual forecasting methods, Time series fore casting methods, and Routine short term fore casting methods, Selection of forecasting model.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Khanna,O.P: Industrial Engineering and Management,DhanpatRai and Sons,2008.	
2	SK Sharma and Savita Sharma: Industrial Engineering and Organization Management, , S K Kataria& Sons, Edition 1, 2011.	
3	Martad.T.Telsang:Industrial Engineering and Production Management”S.ChandPublishing,1999.	

REFERENCES:		
1	Prasanna Chandra: “Projects: Planning, Analysis, Selection, Financing, Implementation, and Review”, Tata McGraw Hill, 8thEdition	
2	DilipR.Sule:Industrialscheduling–PWSPublishingcompany,Boston,1997.	
3	James Apple,M,Plant layout and Material Handling,JohnWiley,3rd Edition,1977.	
4	Sundaresh.S.Heragu,FacilitiesDesign,4thedition,CRCpress,2016	

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Evaluate the work methods through work measurement
CO2:	Identify a suitable layout for a Plant by considering appropriate factors for minimizing the movement of Men, Materials and Floor space thereby maximizing the Utilization Capacity
CO3:	Initiate, plan, execute, regulate and complete a Project within the set scope, time, quality and budget standards
CO4:	Understand the various components and functions of Production Planning and Control
CO5:	Manage Inventory effectively with suitable forecasting 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	2	2	2	3	3
CO2	3	3	3	3	3	2	2	2	2	2	3	3	3	3
CO3	2	2	2	2	2	2	1	2	2	1	2	3	3	3
CO4	2	2	2	2	2	1	1	1	1	1	2	2	3	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	3	3
Avg.	2	2	2	2	2	2	2	2	2	2	2	3	3	3

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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2438	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Understand the complete process of product development from idea to market. - Learn systematic concept generation, selection, and evaluation. - Develop knowledge of product architecture and its influence on design. - Appreciate the role of industrial design and manufacturing considerations. - Learn the principles of prototyping and methods for economic analysis. - Gain exposure to project management techniques for product development.					

Unit-I	PRODUCT DEVELOPMENT AND CONCEPT SELECTION	(9)
Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.		
Unit-II	PRODUCT ARCHITECTURE	(9)
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.		
Unit-III	INDUSTRIAL AND MANUFACTURING DESIGN	(9)
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors.		
Unit-IV	PROTOTYPING AND ECONOMIC ANALYSIS	(9)
Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors		
Unit-V	MANAGING PRODUCT DEVELOPMENT PROJECTS	(9)
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999	
2	Charles Gevirtz, Developing New products with TQM, McGraw – Hill International editions, 1994	
3	Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.	


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REFERENCES:

1	Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2	Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.
3	Karal .T. Ulrich, Steven D.Eppinger, Product Design and Development, McGRAW- HILL International Editions.2003.

COURSE OUTCOMES:

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

CO1:	Understand and explain the various stages of product development and concept selection.
CO2:	Analyze and apply the principles of product architecture for effective design integration.
CO3:	Integrate industrial design and manufacturing factors into product development.
CO4:	Apply prototyping techniques and perform economic analysis of product development.
CO5:	Manage product development projects using appropriate tools and strategies.

Mapping of COs with POs and PSOs

COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	2	2	1	-	-	-	-	2	2	1	-	-	-
CO2	3	3	3	2	2	-	-	-	2	2	-	-	-	-
CO3	3	3	3	2	3	-	-	-	2	2	-	-	-	-
CO4	3	3	3	2	2	-	-	-	2	2	-	-	-	-
CO5	3	2	3	2	3	-	-	-	3	3	2	-	-	-
Avg.	3	2.6	2.8	1.8	2.5	-	-	-	2.2	2.2	1.5	-	-	-

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2439	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To introduce the process planning concepts to make cost estimation for various products after process planning. - To learn the various Process Planning Activities. - To provide the knowledge of importance of costing and estimation. - To provide the knowledge of estimation of production costing. - To learn the knowledge of various Machining time calculations.					

Unit-I	INTRODUCTION TO PROCESS PLANNING	(9)
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection		
Unit-II	PROCESS PLANNING ACTIVITIES	(9)
Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning-case studies		
Unit-III	INTRODUCTION TO COST ESTIMATION	(9)
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost.		
Unit-IV	PRODUCTION COST ESTIMATION	(9)
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.		
Unit-V	MACHINING TIME CALCULATION	(9)
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Pete r scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.	
2	Sinh a B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.	


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REFERENCES:

1	Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2	Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
3	Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4	Mik ell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5	K.C . Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", KhannaPublishers 1990.

COURSE OUTCOMES:

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

CO1:	Discuss select the process, equipment and tools for various industrial products.
CO2:	Explain the prepare process planning activity chart.
CO3:	Explain the concept of cost estimation.
CO4:	Compute the job order cost for different type of shop floor.
CO5:	Calculate the machining time for various machining operations.

Mapping of COs with POs and PSOs

COs/P Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	1	1	1	2	1	1
CO2	3	3	2	1	-	-	-	-	1	1	1	2	1	1
CO3	3	3	2	2	-	-	-	-	1	1	1	2	1	1
CO4	3	3	2	2	-	-	-	-	1	1	1	2	1	1
CO5	3	3	2	2	-	-	-	-	1	1	1	2	1	1
Avg.	3	3	2	1.8	-	-	-	-	1	1	1	2	1	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2440	LEAN AND AGILE MANUFACTURING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the foundational principles of Lean and Agile manufacturing. - To identify wastes and apply Lean tools to eliminate them. - To explore enablers and technologies supporting agility in manufacturing. - To provide knowledge on implementing Lean and Agile strategies in industries. - To evaluate and integrate Lean and Agile principles with Industry 4.0.					

Unit-I	INTRODUCTION TO LEAN MANUFACTURING	(9)
Evolution of manufacturing systems: From craft to mass to lean production - Concept and definition of Lean Manufacturing- Comparison: Traditional Manufacturing vs Lean Manufacturing-Toyota Production System (TPS): Philosophy and pillars (JIT & Jidoka)-Principles of Lean Thinking (Womack & Jones)-The 7 Wastes (Muda): Overproduction, Waiting, Transport, Over processing, Inventory, Motion, Defects - Lean metrics: Cycle time, Takt time, Lead time, OEE-Introduction to Lean Culture and Lean Transformation Roadmap.		
Unit-II	LEAN TOOLS AND TECHNIQUES	(9)
5S (Sort, Set in order, Shine, Standardize, Sustain)-Kaizen: Continuous improvement culture-Value Stream Mapping (VSM): Current state and future state mapping-Kanban: Pull system implementation-Just-In-Time (JIT) and Line Balancing-Poka-Yoke: Error-proofing techniques-Single Minute Exchange of Die (SMED)-Standard Work and Takt time calculations-Visual Management and lean workplace design - Cellular manufacturing and Lean layout principles		
Unit-III	AGILE MANUFACTURING CONCEPTS	(9)
Concept of Agility in Manufacturing-Agile vs Lean: Key differences and similarities-Characteristics of Agile Manufacturing: Flexibility, Responsiveness, Speed-Agile manufacturing enablers: Technology, People, Organization, Innovation-Role of IT, CAD/CAM, Internet of Things (IoT)-Role of Concurrent Engineering and Knowledge Management-Mass customization vs mass production-Rapid prototyping and Quick response manufacturing (QRM)-Reconfigurable Manufacturing Systems (RMS).		
Unit-IV	IMPLEMENTATION OF LEAN AND AGILE SYSTEMS	(9)
Strategy for Lean Implementation: Top-down vs bottom-up-Steps in Lean transformation: Planning, Pilot, Roll-out-Role of leadership and cross-functional teams-Employee involvement and culture change -Lean training and skill development-Framework for Agile deployment-Case studies on Lean and Agile implementation in industries (Automotive, Aerospace, Electronics)-Industry success stories and lessons learned.		
Unit-V	INTEGRATION OF LEAN AND AGILE SYSTEMS	(9)
Need for hybrid systems: Combining Lean's efficiency with Agile's responsiveness-Challenges in integration and balancing trade-offs-Lean-Agile supply chains and value networks- Role of digital manufacturing and real-time data (Industry 4.0)-Metrics for evaluating Lean-Agile systems: Flexibility, Lead time, Inventory turns, Customer satisfaction- Advanced topics: Cyber-physical systems, Smart factories-Benchmarking and best practices for world-class manufacturing.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Rajesh Jugulum, "Lean Six Sigma", Pearson Education, 2016.
2	Yusuf, Sarhadi&Gunasekaran, "Agile Manufacturing: The 21st Century Competitive Strategy", Elsevier Press, 1999.

REFERENCES:

1	Liker, Jeffrey K., "The Toyota Way", McGraw-Hill, 2004.
2	Mike Rother and John Shook, "Learning to See: Value Stream Mapping", Lean Enterprise Institute.
3	P. Nicolas, R. Thomas, "Lean and Green Supply Chain Management", Springer, 2016.
4	Bicheno J., "The Lean Toolbox", Picsie Books, 5th Edition, 2016.
5	Goldman, Nagel &Preiss, "Agile Competitors and Virtual Organizations", Van Nostrand, 1995.

COURSE OUTCOMES:

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

CO1:	Explain the fundamental principles and evolution of Lean Manufacturing.
CO2:	Apply Lean tools like VSM, Kaizen, Kanban, and 5S to eliminate waste and improve process efficiency.
CO3:	Differentiate between lean and agile manufacturing and identify agile enablers.
CO4:	Develop a strategy for implementing lean and agile systems in an organization.
CO5:	Evaluate the performance and integration of lean-agile systems for enhanced productivity and responsiveness.

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	1	-	1	1	3	2
CO2	3	2	3	-	-	-	-	1	1	-	1	1	3	2
CO3	3	3	2	-	-	-	-	1	1	-	1	1	3	2
CO4	3	2	3	2	-	-	-	1	1	-	1	1	3	2
CO5	3	2	3	3	-	-	-	1	1	-	1	1	3	2
Avg.	3	2.2	2.2	1	-	-	-	1	1	-	1	1	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2441	INDUSTRIAL SAFETY AND MAINTENANCE ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	The course explores the awareness and knowledge on safety aspects, procedures and guidelines to be followed in the industry while performing various types of operations in industry.					

Unit-I	INDUSTRIAL SAFETY	(9)
Importance of safety – Causes of accidents – Types of hazards – Safety audit – Safety policy – Accident investigation – Cost of accidents – Safety measures in mechanical, electrical, and chemical industries – PPE – Safety training.		
Unit-II	MAINTENANCE CONCEPTS AND STRATEGIES	(9)
Objectives of maintenance – Types: corrective, preventive, predictive, breakdown – Total Productive Maintenance (TPM) – Maintenance planning and scheduling – CMMS (Computerized Maintenance Management System)-Maintenance organization structure-Planning and scheduling of maintenance tasks- Introduction to Computerized Maintenance Management Systems (CMMS)-Maintenance documentation and work orders		
Unit-III	CONDITION MONITORING TECHNIQUES	(9)
Vibration monitoring – Thermography – Ultrasonics (leak detection, thickness measurement) – Lubricant analysis – Noise and acoustic monitoring – NDT techniques – Signature analysis –Acoustic emission and noise monitoring- Online monitoring systems-Calibration and selection of sensors and instruments.		
Unit-IV	RELIABILITY AND FAILURE ANALYSIS	(9)
Failure modes – FMEA (Failure Mode and Effects Analysis) – Fault Tree Analysis (FTA) – Reliability, availability, maintainability – MTBF, MTTR – Weibull distribution – Replacement strategies. Reliability concepts: MTBF (Mean Time Between Failure), MTTR (Mean Time to Repair), MTTF- Reliability calculations using exponential and Weibull distributions-Redundancy, availability, maintainability-Failure data analysis and trend plotting-Replacement policies: age replacement, economic replacement		
Unit-V	MAINTENANCE PERFORMANCE AND ECONOMICS	(9)
Maintenance performance metrics: downtime, availability, overall equipment effectiveness (OEE)- Maintenance cost analysis-Life Cycle Costing (LCC) of equipment-Economic evaluation methods (Payback period,Net Present Value (NPV),Internal Rate of Return (IRR))-Inventory and spare parts management -Case studies on maintenance improvements and cost-benefit analysis -Design for maintainability – engineering design considerations		
Total No of Periods to be Taught		45

TEXT BOOK:

1	Raghavan, K. & Narayan, K.P., Power Plant Engineering and Maintenance, Scitech Publications,2012.
2	Amitabh Bhattacharya, Industrial Safety and Environment, University Science Press,2004.


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REFERENCES:

1	Frank R. Spellman, Safety Engineering: Principles and Practices, Bernan Press,1960.
2	P. Gopalakrishnan& A.K. Banerji , <i>Maintenance and Spare Parts Management</i> , PHI,2008.
3	Moubray, J., Reliability Centered Maintenance, Industrial Press,2007.
4	Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK,2003.
5	Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press.2 nd Edition 1990.

COURSE OUTCOMES:

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

CO1:	Understand the principles of industrial safety and accident prevention.
CO2:	Apply appropriate maintenance strategies to improve equipment reliability.
CO3:	Use condition monitoring tools for predictive maintenance.
CO4:	Perform reliability analysis and fault diagnosis using engineering tools.
CO5:	Analyze maintenance performance using economic and statistical methods.

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	1	1	-	1	1	-	-	-	-	-	-	-
CO2	2	2	1	1	-	1	1	-	-	-	-	-	-	-
CO3	2	2	1	1	-	1	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	-
Avg.	2.4	2.8	1	1	-	0.6	0.4	-	-	-	-	-	-	-

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2442	PROJECT PLANNING AND MANAGEMENT	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To understand the various techniques of Project planning and execute the project efficiently. - To achieve the project's main goal within the given constraints. - To optimize the allocated necessary inputs and their application meeting the project's pre-defined objectives. - To complete the project this follows the client's exclusive needs.					

Unit-I	PROJECT MANAGEMENT AND INITIATION	(9)
Definition of Project, Project Life Cycle, Selection and criteria of choice, selection models and analysis under uncertainty-the management of risk, project portfolio process, project proposals. Role of project managers, problems of cultural differences, impact of institutional environments, multi cultural communication and managerial behaviour. Working and partnering with others – Nature of negotiation, partnering, chartering and scope change, conflict and the project life cycle, requirements and principles of negotiation.		
Unit-II	PROJECT PLANNING AND TOOLS	(9)
Initial project coordination and the project plan, systems integration, the action plan. Project costs and Budgets – estimating project budgets, expert opinion, analogy, parametric estimate; cost engineering – example, contingency amount, elements of budgets and estimates improving the process of cost estimation.		
Unit-III	RESOURCE AND RISK MANAGEMENT	(9)
Allocating resources on the project – crashing a project, resource allocation problem, resource loading, resource leveling, constrained resource scheduling, multi-project scheduling and resource allocation. Risk analysis – objectives of risk analysis, identify the risk, determine the most important risk, and identify control measures.		
Unit-IV	PROJECT CONTROL, EVALUATION AND TERMINATION	(9)
The planning, monitoring and controlling cycle, information needs and reporting, earned value analysis, computerized PMIS. Controlling Project execution – fundamental purpose of control, types of control processes, design of control system, control of change and scope creep. Project evaluation – goals of the system, project audit, construction and use of audit report, project audit lifecycle.		
Unit-V	PROJECT FEASIBILITY ANALYSIS	(9)
Marketing Feasibility: Types of market - identification of investment opportunities - market and demand analysis - forecasting demand (review) - forecast control - Secondary sources of information. Technical Feasibility: Product design-concept of concurrent engineering make Vs buy decisions – BPO – value analysis – FAST approach – product life cycle management.		


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Total No of Periods to be Taught		45
TEXT BOOK:		
1	Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review", Tata McGrawHill, 8th Edition..	
2	Clifford. F. Gray, Erik. W. Larson and Gautam. V. Desai "Project Management: The Managerial Process", Tata McGraw Hill, 6th Edition.	

REFERENCES:	
1	John M Nicholas, "Project Management for Business and Technology", Prentice Hall India Pvt. Ltd., NewDelhi,2002.
2	Anastasia Pagnoni, "Project Engineering–Computer Oriented Planning and Operational Decision Making", Springer Verlag, 1990.
3	ParameshwarPiyer, "Engineering Project Management-with Case Studies", Wheeler Publishing, 1996.
4	Joseph Phillips, "IT Project Management on Track from Start to Finish", Tata McGraw Hill, 2004.
5	Jack R Meredith and Samuel J Mantel, "Project management: A Managerial Approach", John Wiley & Sons, Inc., New Delhi,

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Understand the requirements of project management.
CO2:	Learn the Tools for project planning.
CO3:	Understand the allocation of Resources and Risk management.
CO4:	Evaluate and Control the progress of the Project.
CO5:	Learn to conduct the feasibility 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	3	3	3	3	2	2	1	2	2	3	3	3	3
CO2	3	3	3	3	3	2	2	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	2	1	2	2	3	3	3	3
CO4	3	3	3	3	3	2	2	1	2	2	3	3	3	3
CO5	3	3	3	3	3	2	2	1	2	2	3	3	3	3
Avg.	3	3	3	3	3	2	2	1	2	2	3	3	3	3
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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2443	PROJECT PLANNING AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To get an introductory insight about the IPR in national and international context - To understand the procedures for IPR, registration and its enforcement. - To encourage innovation and to provide incentives for innovation by granting protection to inventors that will allow them to recover research and development investments - To protect inventors or creators of intellectual products with moral and commercial value.					

Unit-I	INTRODUCTION	(9)
Intellectual property: Introduction, Meaning, Nature and significance types of intellectual property, importance of intellectual property rights, Protection of human innovations by IPR such as Patents, Trademarks, Copyright, Industrial Designs Geographical Indications, and Trade Secrets.		
Unit-II	AGREEMENTS AND TREATIES	(9)
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, General agreement on trade and tariff (GATT), Ben convention, Rome convention, Role of WTO and WIPO.		
Unit-III	PATENTS	(9)
Concept of Patent – Historical view of Patent system in India and International Scenario, patent searching process, ownership rights and transfer, compulsory licenses, Procedure for filing of patents, Grants of patent, Benchmarks for patentability of inventions, Recent key changes and development.		
Unit-IV	TRADEMARKS AND COPYRIGHTS	(9)
Concept of Trademarks and copyrights – Rationale behind the protection- Purpose, function and acquisition, ownership issues, Procedure for Registration, Industrial design and integrated circuits, protection of geographical indications and plant varieties, Recent Trends in copyrights and Trademark., Trade secrets -liability for misappropriations of trade secrets.		
Unit-V	LEGAL ASPECTS AND NEW DEVELOPMENTS	(9)
Infringements of patents– Criteria of Infringement – Modes of Infringement remedies and modification Protection against unfair competition, enforcement of intellectual property rights, Intellectual property audits, New developments of intellectual property, Impact of international instruments relating to the protection of intellectual properties Future of IPR in National and International levels.		
Total No of Periods to be Taught		45

TEXT BOOK:

1	S.V. Satarkar, Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2002.
2	V. ScopleVinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
3	P.Narayanan, Intellectual property rights Eastern law house-2018 3rd Edition (revised and updated)
4	Deborah, E. Bouchoux, Intellectual property right, Cengage learning 2018 5th Edition


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REFERENCES:

1	Sterling, J. L. A., World copyright law, (2008) 3rd Edition, London, Sweet & Maxwell
2	GP Reddy, Intellectual property rights & other laws, Gogia law agency
3	Barrett, Margreth, Intellectual Property, (2009) 3rd Edition, New York Aspen publishers.

COURSE OUTCOMES:

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

CO1:	Understand the concepts of Intellectual property rights.
CO2:	Demonstrate the agreements and treaties of Intellectual property rights
CO3:	Explore needs and avenues for patents
CO4:	Explore the necessity of Trademarks and Copy rights
CO5:	Understand the legal context and developments of Intellectual property rights

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	1	1	-	-	1	2	1
CO2	3	1	3	1	2	-	1	1	-	-	-	1	2	1
CO3	1	1	2	2	2	-	1	1	-	-	-	1	1	1
CO4	2	1	1	2	2	-	1	1	-	-	-	1	1	2
CO5	1	1	1	2	2	2	1	1	-	-	-	1	2	2
Avg.	1	1	1	2	2	2	1	1	1	-	-	1	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2444	DIGITAL MANUFACTURING AND IoT	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To study the various aspects of digital manufacturing. • To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management. • To formulate of smart manufacturing systems in the digital work environment. • To interpret IoT to support the digital manufacturing. • To elaborate the significance of digital twin.					

Unit-I	INTRODUCTION	(9)
Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.		
Unit-II	DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT	(9)
Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM		
Unit-III	SMART FACTORY	(9)
Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity.		
Unit-IV	INDUSTRY 4.0	(9)
Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.		
Unit-V	STUDY OF DIGITAL TWIN	(9)
Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow-Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins..		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.	
2	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.	


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REFERENCES:

1	Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3	Alp Ustundag and EmreCevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4	Ronald R. Yager and Jordan PascualEspada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
5	Ronald R. Yager and Jordan PascualEspada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

COURSE OUTCOMES:

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

CO1:	Impart knowledge to use various elements in the digital manufacturing.
CO2:	Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.
CO3:	Select the proper procedure of validating practical work through digital validation in Factories.
CO4:	Implementation the concepts of IoT and its role in digital manufacturing.
CO5:	Analyse and optimize various practical manufacturing processes through digital twin.

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	1	3	3	-	1	2	2	-	2	3	2
CO2	3	2	3	1	3	3	2	2	2	2	-	2	3	2
CO3	3	-	3	1	3	3	2	-	3	2	-	2	3	2
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2
CO5	3	-	2	2	1	3	-	2	2	2	-	2	3	2
Avg.	3	2	3	2	3	3	2	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2445	QUALITY ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	- Developing a clear knowledge in the basics of various quality concepts. - Facilitating the students in understanding the application of control charts and its techniques. - Developing the special control procedures for service and process oriented industries. - Analyzing and understanding the process capability study. - Developing the acceptance sampling procedures for incoming raw material.					

Unit-I	INTRODUCTION	(9)
Quality Dimensions–Quality definitions–Inspection–Quality control–Quality Assurance–Quality planning–Quality costs–Economics of quality– Quality loss function		
Unit-II	CONTROL CHARTS	(9)
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.		
Unit-III	SPECIAL CONTROL PROCEDURES	(9)
Warning and modified control limits, control chart for individual measurements, multi-vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.		
Unit-IV	STATISTICAL PROCESS CONTROL	(9)
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.		
Unit-V	ACCEPTANCE SAMPLING	(9)
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS 2500 standards.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Douglas.C. Montgomery, "Introduction to Statistical quality control", 7 th edition, John Wiley 2012.	
2	Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2008.	

REFERENCES:	
1	Bester field D.H., "Quality Control", Prentice Hall, 2013.
2	Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
3	Grant, Eugene.L "Statistical Quality Control", McGraw-Hill, 2017
4	Gupta.R.C, "Statistical Quality control", Khanna Publishers, 2001.


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COURSE OUTCOMES:

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

CO1:	Control the quality of processes using control charts for variables in manufacturing industries.
CO2:	Control the occurrence of defective product and the defects in manufacturing companies.
CO3:	Control the occurrence of defects in services.
CO4:	Analyzing and understanding the process capability study.
CO5:	Developing the acceptance sampling procedures for incoming raw material.

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	2	-	-	2	1	-
CO2	-	3	3	-	3	-	-	-	3	-	-	3	-	2
CO3	3	3	3	-	3	-	-	-	3	-	-	3	1	-
CO4	3	-	2	-	3	-	-	-	-	-	1	-	1	-
CO5	-	-	2	-	3	-	-	-	3	-	-	3	-	-
Avg.	2.6	2.7	2.7	-	3	-	-	1	2.7	-	1	2.7	1	2

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Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2446	AUTOMOBILE ENGINEERING	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To study the construction and working principle of various parts of an automobile. • To study the practice for assembling and dismantling of engine parts and transmission system • To study various transmission systems of automobile. • To study about steering, brakes and suspension systems • To study alternative energy sources					

Unit-I	VEHICLE STRUCTURE AND ENGINES	(9)
Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).		
Unit-II	ENGINE AUXILIARY SYSTEMS	(9)
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS)		
Unit-III	TRANSMISSION SYSTEMS	(9)
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.		
Unit-IV	STEERING, BRAKES AND SUSPENSION SYSTEMS	(9)
Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control..		
Unit-V	ALTERNATIVE ENERGY SOURCES	(9)
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.	
2	Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.	


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REFERENCES:

1	Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012
2	Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3	Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999
4	Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
5	Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

COURSE OUTCOMES:

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

CO1:	Apply the working principles of fluid power systems and hydraulic pumps.
CO2:	Apply the working principles of hydraulic actuators and control components.
CO3:	Design and develop hydraulic circuits and systems.
CO4:	Apply the working principles of pneumatic circuits and power system and its components.
CO5:	Identify various troubles shooting methods in fluid power 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	2	1	2	-	-	-	-	-	1	-	1	1	2	1
CO2	2	1	2	-	-	-	-	-	1	-	1	1	2	1
CO3	2	1	2	-	-	-	-	-	1	-	1	1	2	1
CO4	2	1	2	-	-	-	-	-	1	-	1	1	2	1
CO5	2	1	2	-	-	-	-	-	1	-	1	1	2	1
Avg.	2	1	2	-	-	-	-	-	1	-	1	1	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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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2447	ELECTRIC AND HYBRID VEHICLES	L	T	P	C	100
		3	0	0	3	
Course Objectives	• Give the students the idea of global energy scenario, pollution levels and green mobility technology solutions • Make the students understand the basics of traction batteries, their operating characteristics, charging and management system. • Understand the basics of power electronics used in hybrid and electrical vehicles • Explain the characteristics of traction motors, their performance and vehicle performance • Familiarize with electromagnetic interference and EV testing standards.					

Unit-I	INTRODUCTION	(9)
Global energy scenario - Electric and hybrid vehicle - need, advantages, challenges - layout, components. Hybrid vehicle – advantages, disadvantages, architecture – series, parallel, plug-in, mild and assist hybrid. Hybrid vehicle operating modes – Fuel cells – basics, types, advantages and disadvantages.		
Unit-II	TRACTION BATTERIES	(9)
Targets and properties of batteries, Li-Po battery, Li ion battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminum Air Battery, Super capacitors. Battery charging - battery charging profile charging time –charging standards – charging methods – charging modes – vehicle to grid technology – Tesla power wall –Wireless power transfer – Regenerative Braking - Battery management System.		
Unit-III	POWER ELECTRONICS FOR EV AND HEV	(9)
Semiconductor power diodes, transistors, thermistors, triacs, GTOs. AC-DC converters, DC-DC converters and types – buck, boost, fly back. Isolated converters. Inverters based on MOSFET. Microcontrollers/DSP based controllers, Types of sensors for electric drive, Current sensors and signal conditioners.		
Unit-IV	MOTORS FOR ELECTRIC VEHICLE	(9)
Introduction –Motor and engine ratings- motor torque and power characteristics – EV motor sizing - Construction and working principle of DC machines, BLDC Motor, three phase AC machines, PM and SR machines – Design criteria of DC motor drives, induction motor drives and PM/SRM motor drives for EVs. –Acceleration Performance and Vehicle Power - Final Drive - Speed Calculation with a Torque Profile		
Unit-V	ELECTROMAGNETIC INTERFERENCE & EV TESTING	(9)
EMI – Noise propagation modes – cabling – components – PCB EMC – SAE Automotive EMC standards – SAEJ551- SAE J 1113 – Test methodology - Need for testing EVs – Safety checklist (AIS 038). – significance of isolation resistance - measurement of isolation resistance – water tests(flood test/ wash test/ rain test) motor power test (AIS 041) – chassis dynamometer – motor dynamometer (motor test bed) – Energy consumption test(AIS 039) – battery testing (AIS 048) – steps for reducing the energy consumption – Range test (AIS 040) –FAME scheme of INDIA.		
Total No of Periods to be Taught		45


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TEXT BOOK:

1	Tom Denton. "Electric and Hybrid Vehicles" Routledge Publications, 2016.
2	MehrdadEhsani, YiminGao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2018.
3	Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2017

REFERENCES:

1	Chau. K. T. "Electric Vehicle Machines and Drives – Design, Analysis and Application", John Wiley & Sons Singapore Pte. Ltd., 2015
2	Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 24-Oct-2014
3	Power Electronics and Motor Drives, Bogdan M. Wilamowski, J. David Irwin, CRC Press, 2016
4	Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
5	Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

COURSE OUTCOMES:

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

CO1:	Illustrate the concept of electric vehicles and its propulsion system
CO2:	State the concept of hybrid architecture and power plan.
CO3:	List the energy storage systems.
CO4:	Explain about the fuel cells
CO5:	Explain about the fuel cells

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
CO2	3	-	3	-	2	-	-	-	-	-	-	-	-	2
CO3	3	-	3	-	2	-	-	-	-	-	-	-	-	2
CO4	3	-	3	-	2	-	-	-	-	-	-	-	-	2
CO5	3	-	3	-	2	-	-	-	-	-	-	-	-	2
Avg.	3	-	3	-	2	-	-	-	-	-	-	-	-	2

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


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Mecheri, Salem Dt-636453, Tamilnadu



Department	Mechanical	Programme Code & Name	114-Mechanical
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Professional Electives - (Stream – IV Industrial Engineering)

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEPE2448	VEHICLE HEALTH MONITORING, MAINTENANCE AND SAFETY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- To enable the student to understand the principles, functions and practices adapted in maintenance activities of vehicles. - To study the power train maintenance, fault diagnosis, maintenance of Batteries - To develop vehicle system maintenance and service of clutch, brake. - To study the concepts of vehicle safety and regulations. - To study and understand the simulation of safety concepts					

Unit-I	INTRODUCTION	(9)
Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools;		
Unit-II	POWERTRAIN MAINTENANCE	(9)
Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.		
Unit-III	VEHICLE SYSTEM MAINTENANCE	(9)
Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering.		
Unit-IV	VEHICLE SAFETY	(9)
Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.		
Unit-V	SIMULATION OF SAFETY CONCEPTS	(9)
Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.		
Total No of Periods to be Taught		45
TEXT BOOK:		
1	5th Edition, “Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle . Maintenance and Repair” By Tom Denton	
2	Safety Management System and Documentation Training Programme Handbook by S. V. . Paul ISBN: 9788123923444	


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REFERENCES:

1	Ed May, "Automotive Mechanics Volume One" and Two, McGraw Hill Publications, Tenth edition, 2018
2	Bosch Automotive Handbook, Tenth Edition, 2018.
3	Jack Erjavek, "A systems approach to Automotive Technology", Cengage Learning, 5 thEdition, 2012
4	William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tata McGraw Hill, 10th Edition, 2004.
5	Vehicle Service Manuals of Reputed Indian Manufacturers.

COURSE OUTCOMES:

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

CO1:	The students have the knowledge of vehicle health monitoring, maintenance and safety.
CO2:	The students able to maintenance of powertrain.
CO3:	The students can ability to maintenance of Vehicle system.
CO4:	Explain and awareness of vehicle safety.
CO5:	Explain the simulation of safety concepts

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	2	2	1	1	-	-	-	1	-	1	3	2	2
CO2	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO3	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO4	3	2	2	1	1	-	-	-	1	-	1	3	2	2
CO5	3	2	2	1	1	-	-	-	1	-	1	3	2	2
Avg.	3	2	2	1	1	-	-	-	1	-	1	3	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	-	-	-

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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	-	-	-

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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
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	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, fgetc, fputc-File Modes and Applications.		
Total No of Periods to be Taught		30 Periods

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TEXT BOOK:

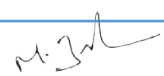
1	E. Balagurusamy, Programming in ANSI C, McGraw Hill, 9th Edition, 2024.
2	Kernighan & Ritchie, The C Programming Language, 2nd Edition, 1988.

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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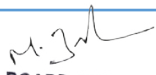
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2402	Introduction to Data Structures		L	T	P	C	100
			2	0	2	3	
Course Objectives	- To understand fundamental data structures. - 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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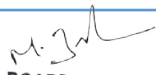
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd Edition, 1997.
2	Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia, 1976.

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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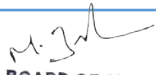
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS	
Course Code	Course Name		Hours/Week			Credit	Maximum Marks	
UCSOE2403	Data Science Fundamentals		L	T	P	C	100	
			2	0	2	3		
Course Objectives		• Familiarize students with the data science 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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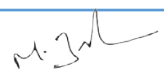


Total No of Periods to be Taught	30 Periods
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TEXT BOOK:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

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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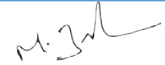
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Department		CSE	Programme Code & Name				OPEN TO ALL DEPARTMENTS
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCSOE2404	Introduction of Data Analytics		L	T	P	C	100
			2	0	2	3	
Course Objectives	- Understand the fundamental concepts of 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
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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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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:

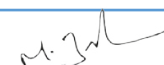
- | | |
|---|---|
| 1 | Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997. |
| 2 | I. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011. |
| 3 | C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. 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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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:

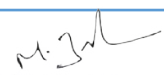
1	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.
2	Samuel Greengard, The Internet of Things, The MIT Press, 2015.

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 de 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
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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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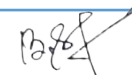
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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2402	IMAGE PROCESSING AND COMPUTER VISION	L	T	P	C	100
		3	0	0	3	
Course 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

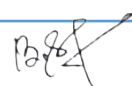
REFERENCES:

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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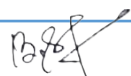
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Mapping of COs with POs and PSOs

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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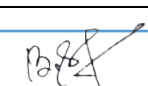


Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2403	4G / 5G COMMUNICATION NETWORKS	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To learn the evolution of wireless networks. • 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:

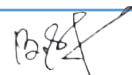
On completion of the course, the students will be able to

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:

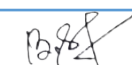
On completion of the course, the students will be able to

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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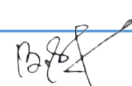
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Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2405	EMBEDDED AND REAL TIME SYSTEMS	L 3	T 0	P 0	C 3	100
Course Objectives	- 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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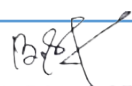
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Mapping of COs with POs and PSOs

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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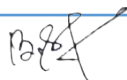
REFERENCES:

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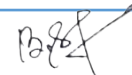
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Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	-	-	-	-	-	-	3	1	-
CO2	3	3	3	1	3	-	-	-	-	-	-	3	3	-
CO3	3	3	1	3	3	-	-	-	-	-	-	3	1	-
CO4	3	3	1	3	3	-	-	-	-	-	-	3	1	-
CO5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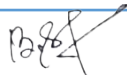


Department	ECE	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UECOE2407	INDUSTRIAL IOT	L 3	T 0	P 0	C 3	100
Course Objectives	- To understand the fundamentals of Internet of Things. - To learn 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:

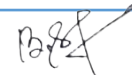
On completion of the course, the students will be able to

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

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
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, Inclometers		
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:

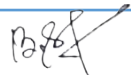
On completion of the course, the students will be able to

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

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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	-	-	-	-	-	-	-	-	-	-

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
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

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
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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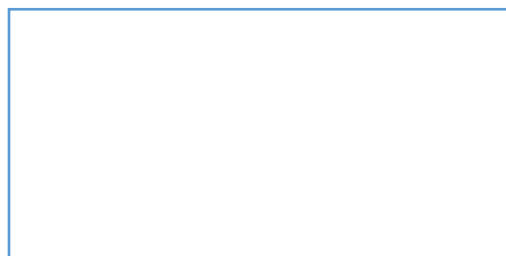
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Department	Mechanical	Programme Code & Name	Open to all Departments
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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UMEOE2404	ENERGY TECHNOLOGY	L	T	P	C	100
		3	0	0	3	
Course Objectives	- 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	-	-	-

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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	-	-	-

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
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	-	-	-

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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
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	-	-	-

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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,nshelf 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	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	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

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		
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		-	-

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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	-	-	-

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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. etal., “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	-	-	-

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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:

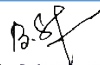
On completion of the course, the students will be able to

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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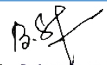
Semester

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:

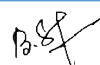
On completion of the course, the students will be able to

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	-	-	-

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
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:

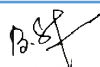
On completion of the course, the students will be able to

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	-	-	-	-	-	-	-

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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	-	-	-

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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	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	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 braking – 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
UEEOE2405	ELECTRICAL ESTIMATION AND COSTING	L	T	P	C	100
		3	0	0	3	

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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.	
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”, Dhanpat Rai 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
UEEOE2409	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C	100
		3	0	0	3	

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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

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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:

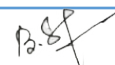
On completion of the course, the students will be able to

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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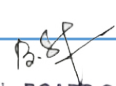


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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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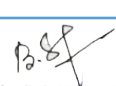


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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:

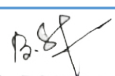
On completion of the course, the students will be able to

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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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
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:

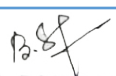
On completion of the course, the students will be able to

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	-

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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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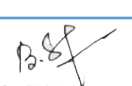


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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	

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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


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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 Kotler 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	

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
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:

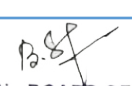
On completion of the course, the students will be able to

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	

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
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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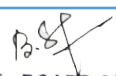


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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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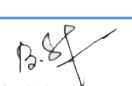


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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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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
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	

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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	

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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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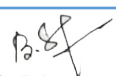
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Department	BME	Programme Code & Name				121-BE- BME	
Semester							
Course Code	Course Name		Hours/Week			Credit	Maximum Marks
UCMG2420	DATAMINING FOR BUSINESS INTELLIGENCE		L	T	P	C	100
			3	0	0	3	
Course Objectives	- To know how to derive meaning 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 Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6.	.Michel Berry and Gordon Linoff, 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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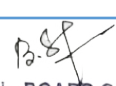


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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,ANDSUSTAINABLECONCEPTS	(9)
Ecosystem definition - Biotic V/s. 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	SOILHEALTH,NUTRIENTAND PESTMANAGEMENT	(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 a vailability-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	ENERGYAND 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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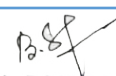
REFERENCES:

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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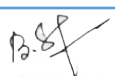


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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 implants ● 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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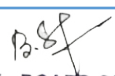


Department	BME	Programme Code & Name	121-BE- BME
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Semester

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, Sodiatered 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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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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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	Greenchemistrymetrics- 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:	To understand the principles of green engineering and technology
CO2:	To learn about pollution using hazardous chemicals and solvents
CO3:	To modify processes and products to make them green and safe.
CO4:	To design processes and products using green technology
CO5:	To understand advanced technology in green synthesis


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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, Frank R. 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 ICFAI 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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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

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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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