THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)
Mecheri, Salem - 636 453

Approved by AICTE, New Delhi
Affiliated to Anna University, Chennai

DEPARTMENT OF
BIOMEDICAL ENGINEERING



AUTONOMOUS
CURRICULUM AND

SYLLABUS
I-VIII
SEMESTER

UG
REGULATION
2024
Academic Year 2024-25 onwards

The Kavery Engineering College
Mecheri, Mettur Tk. Salem Dt – 636 453.
(An Autonomous Institution Approved by AICTE, New Delhi & Affiliated to Anna University)
An ISO 9001:2015 certified Institution and accredited by NAAC with A+ grade.

B.E. BIOMEDICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR SEMESTER I TO VIII

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

VISION

- To be recognized as a leader in offering Biomedical Engineering education, research and application of knowledge to the society.

MISSION

- To equip the students with adequate knowledge in the field Biomedical Engineering with exemplary values.
- To encourage entrepreneurship and mould the students to learn new technologies in healthcare industry.
- To foster research and development in Biomedical Engineering.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will

- To enable the graduates to demonstrate their skills in design and develop medical devices for health care system through the core foundation and knowledge acquired in engineering and biology.
- To enable the graduates to demonstrate their skills in design and develop medical devices for health care system through the core foundation and knowledge acquired in engineering and biology.
- To carry out multidisciplinary research, addressing human health care problems and sustain technical competence with ethics, safety and standards.
- To ensure that graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout their careers.

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PROGRAMME OUTCOMES (POS)

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

PO	Graduate attribute	Programme outcome
1.	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2.	Problem analysis	Identify, formulate, review research literature, and analyse Complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3.	Design/development of solutions	Design solutions for complex engineering problems and design System components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4.	Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5.	Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and Modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
6.	Society & Environment	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. Understand the impact of the professional engineering solutions In societal and environmental contexts, and demonstrate the Knowledge of, and need for sustainable development.
7.	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
8.	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
9.	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
10.	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in Multidisciplinary environments.
11.	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

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PROGRAM SPECIFIC OUTCOMES (PSOs)

On completion of Biomedical Engineering program, the student will have the Following Program Specific outcomes

- To design and develop diagnostic and therapeutic devices that reduces physician burnout and enhances the quality of life for the end user by applying fundamentals of Biomedical Engineering
- To apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.
- To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology

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THE KAVERY ENGINEERING COLLEGE, MECHERI
REGULATIONS - 2024
CHOICE BASED CREDIT SYSTEM
B.E- DEPARTMENT OF BIOMEDICAL ENGINEERING
CURRICULUM & SYLLABI FOR I TO VIII SEMESTERS

SEMESTER – I									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
UIPE24101	Induction Programme	-	-		0	-	-		MC
Theory Course(s)									
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	0	3	40	60	100	ESC
UTAT24106	Heritage of Tamils/ தமிழர் மரபு	1	0	0	1	40	60	100	HSMC
Practical / Employability Enhancement									
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 Course(s)									
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
UBMT24201	Biosciences for Medical Engineering	3	0	0	3	40	60	100	PCC
UBET24202	Basic Electrical and Electronics Engineering	3	0	0	3	40	60	100	ESC
UPHT24206	Medical Physics	3	0	0	3	40	60	100	PCC
UGET24201	Engineering Graphics	2	0	4	4	50	50	100	ESC

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UTAT24201	Tamils and Technology/ தமிழரும் தொழில்நுட்பமும்	1	0	0	1	40	60	100	HSMC
UNCC24001	NSS/ YRC/ Clubs	2	0	0	2*	-	-	-	
Practical / Employability Enhancement									
UGEL24201	Engineering Practices Laboratory	0	0	4	2	60	40	100	ESC
UBML24201	Biosciences Laboratory	0	0	4	2	60	40	100	PCC
UGEL24202	Communication Laboratory /Foreign Language$	0	0	4	2	60	40	100	EEC
Total Credits to be earned					**26**				

$Skill Based Course

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory Courses (s)									
UMAT24301	Transforms and Partial Differential Equations	3	1	0	4	40	60	100	BSC
UBMT24301	Fundamentals of Electronic Devices and Circuits	3	0	0	3	40	60	100	ESC
UBMT24302	Electric Circuit Analysis	3	0	0	3	40	60	100	ESC
UCST24302	Object oriented programming	3	0	0	3	40	60	100	PCC
Theory with Practical Course(s)									
UBMTL24301	Anatomy and Human Physiology	3	0	2	4	50	50	100	PCC
UBMTL24302	Sensors and Measurements	3	0	2	4	50	50	100	PCC
Practical / Employability Enhancement									
UBML24301	Fundamentals of Electronic Devices and Circuits Laboratory	0	0	3	1.5	60	40	100	ESC
UCSL24302	Object oriented Programming Laboratory	0	0	3	1.5	60	40	100	PCC
USD24301	Soft-Skill 1	2	0	0	0	100	-	100	MC
Total Credits to be earned					**24**				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Courses									
UMAT24305	Random Processes and Linear Algebra	3	1	0	4	40	60	100	BSC
UBMT24401	Biomedical Instrumentation	3	0	0	3	40	60	100	PCC
UBMT24402	Analog and Digital Integrated Circuits	3	0	0	3	40	60	100	PCC

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UBMT24403	Bio Control Systems	3	0	0	3	40	60	100	PCC
UESST24401	Environmental Sciences and Sustainability	2	0	0	2	40	60	100	BSC
Theory with Practical Course(s)									
UBMTL24401	Signal Processing	3	0	2	4	50	50	100	PCC
Practical / Employability Enhancement									
UBML24401	Biomedical Instrumentation Laboratory	0	0	2	1	60	40	100	PCC
UBML24402	Analog and Digital Integrated Circuits Laboratory	0	0	2	1	60	40	100	PCC
USD24401	Soft-Skill 2	2	0	0	0	100	-	100	MC
Total Credits to be earned					**21**				

SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Courses									
UBMT24501	Diagnostic and Therapeutic Equipment	3	0	0	3	40	60	100	PCC
	Professional Elective I	3	0	0	3	40	60	100	PEC
	Professional Elective II	3	0	0	3	40	60	100	PEC
	Open Elective–I*	3	0	0	3	40	60	100	OEC
Mandatory Courses									
	Mandatory Course-I[&]	3	0	0	0	40	60	100	MC
Theory with Practical Course(s)									
UBMTL24501	Embedded Systems and IoMT	3	0	2	4	50	50	100	PCC
Practical / Employability Enhancement									
UBML24501	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2	60	40	100	PCC
UIDL24001	Idea lab	0	0	2	1	100	-	100	EEC
USI24501	Summer Internship –I *	0	0	0	1	-	-	100	EEC
USD24501	Soft-Skill 3	2	0	0	-	100	-	100	MC
Total Credits to be earned					**20**				

*** 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 Courses									
UBMT24 601	Medical Imaging Systems	3	0	0	3	40	60	100	PCC
UBMPE24XX	Professional Elective III	3	0	0	3	40	60	100	PEC

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	Open Elective– II**	3	0	0	3	40	60	100	OEC
Mandatory Courses									
	Mandatory Course-II[&]	3	0	0	0	40	60	100	MCC
Theory with Practical Course(s)									
UCSTL24401	Artificial Intelligence and Machine Learning	3	0	2	4	50	50	100	ESC
UBMTL24601	Medical Image Processing	3	0	2	4	50	50	100	PCC
Practical / Employability Enhancement									
UBML24601	Mini Project	0	0	4	2	60	40	100	EEC
USD24601	Soft-Skill 4	2	0	0	-	100	-	100	MC
Total Credits to be earned					**19**				

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory Courses									
UGET24707	Human Values and Ethics	2	0	0	2	40	60	100	HSMC
	Management–Elective[#]	3	0	0	3	40	60	100	HSMC
	Open Elective– III**	3	0	0	3	40	60	100	OEC
	Professional Elective IV	3	0	0	3	40	60	100	PEC
	Professional Elective V	3	0	0	3	40	60	100	PEC
PRACTICALS/INTERNSHIP									
UBML24701	Hospital Training	0	0	0	2	-	-	100	EEC
Total Credits to be earned					**16**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory Courses									
	Open Elective– IV**	3	0	0	3	40	60	100	OEC
	Professional Elective VI	3	0	0	3	40	60	100	PEC
Practical / Employability Enhancement									
UBML24801	Project Work / Internship	--	---	20	10	60	40	100	EEC
Total Credits to be earned					**16**				

TOTAL CREDITS: 164

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ELECTIVE–MANAGEMENTCOURSES

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory Courses									
UGET24701	Principles of Management	3	0	0	3	40	60	100	HSMC
UGET24702	Total Quality Management	3	0	0	3	40	60	100	HSMC
UGET24703	Engineering Economics and Financial Accounting	3	0	0	3	40	60	100	HSMC
UGET24704	Human Resource Management	3	0	0	3	40	60	100	HSMC
UGET24705	Knowledge Management	3	0	0	3	40	60	100	HSMC
UGET24706	Industrial Management	3	0	0	3	40	60	100	HSMC

MANDATORY COURSES

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

Mandatory courses are offered as Non-credit course

PROFESSIONAL ELECTIVES (PEC)

Course Code	Course	Category	Periods/Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
STREAM–I BIO ENGINEERING									
UBMPE2401	Biomaterials	PEC	3	0	0	3	40	60	100
UBMPE2402	Artificial Organs and Implants	PEC	3	0	0	3	40	60	100
UBMPE2403	Biomedical Optics and Bio Photonics	PEC	3	0	3	3	50	50	100
UBMPE2404	Neural Engineering	PEC	3	0	0	3	40	60	100
UBMPE2405	Principles of Tissue Engineering	PEC	3	0	0	3	40	60	100

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UBMPE2406	Genetic Engineering	PEC	3	0	0	3	40	60	100
STREAM–II Management (Healthcare)									
UBMPE2407	Clinical Engineering	PEC	3	0	0	3	40	60	100
UBMPE2408	Hospital Planning and Management	PEC	3	0	0	3	40	60	100
UBMPE2409	Medical Waste Management	PEC	3	0	0	3	40	60	100
UBMPE2410	Economics and Management for Engineers	PEC	3	0	0	3	40	60	100
UBMPE2411	Biostatistics	PEC	3	0	3	3	50	50	100
UBMPE2412	Forensic Science in Healthcare	PEC	3	0	0	3	40	60	100
STREAM–III Advanced Healthcare Devices									
UBMPE2413	Bio MEMS	PEC	3	0	0	3	40	60	100
UBMPE2414	Critical Care And Operation Theatre Equipment	PEC	3	0	0	3	40	60	100
UBMPE2415	Human Assist Devices	PEC	3	0	0	3	40	60	100
UBMPE2416	Advancements in Healthcare Technology	PEC	3	0	0	3	40	60	100
UBMPE2417	Robotics in Medicine	PEC	3	0	0	3	40	60	100
UBMPE2418	Therapeutic Equipment	PEC	3	0	0	3	40	60	100

STREAM– IV Biomedical Communication									
UBMPE2419	Communication Systems	PEC	3	0	0	3	40	60	100
UBMPE2420	Wearable Devices	PEC	3	0	0	3	40	60	100
UBMPE2421	Body Area Networks	PEC	3	0	0	3	40	60	100
UBMPE2422	Virtual Reality and Augmented Reality in Healthcare	PEC	3	0	0	3	40	60	100
UBMPE2423	Tele health Technology	PEC	3	0	3	3	50	50	100
UBMPE2424	Medical Informatics	PEC	3	0	0	3	40	60	100

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OPEN ELECTIVES (OEC)
Open Elective courses offered by Biomedical Engineering to other branches

OPEN ELECTIVE COURSES (For Other Branches)										
S. NO	Course Code	Course	Category	Periods/Week			C	Maximum Marks		
				L	T	P		CA	FE	Total
Theory Course(s)										
1.	UBMOE2401	Basics of Microbial Technology	OEC	3	0	0	3	40	60	100
2.	UBMOE2402	Radiological Equipment	OEC	3	0	0	3	40	60	100
3.	UBMOE2403	Fundamentals of Cell and Molecular Biology	OEC	3	0	0	3	40	60	100
4.	UBMOE2404	Human Physiology	OEC	3	0	0	3	40	60	100
5.	UBMOE2405	Lifestyle Diseases	OEC	3	0	0	3	40	60	100
6.	UBMOE2406	Pathology and Microbiology	OEC	3	0	0	3	40	60	100
7.	UBMOE2407	Medical Electronics	OEC	3	0	0	3	40	60	100
8.	UBMOE2408	Assist Devices	OEC	3	0	0	3	40	60	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 BME Branch
(OPEN ELECTIVES – I, II & III)

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
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

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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
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
Electronics and Communication Engineering									
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
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

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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
Mechanical Engineering									
UMEOE2401	Reverse Engineering	2	0	2	3	50	50	100	OEC
UMEOE2402	Non - Destructive Testing	2	0	2	3	50	50	100	OEC
UMEOE2403	Additive Manufacturing Technology	2	0	2	3	50	50	100	OEC
UMEOE2404	Energy Technology	3	0	0	3	40	60	100	OEC
UMEOE2405	Renewable Energy Technologies	3	0	0	3	40	60	100	OEC
UMEOE2406	Introduction to Industrial Engineering	3	0	0	3	40	60	100	OEC
UMEOE2407	Fiber Reinforced Plastics	3	0	0	3	40	60	100	OEC
UMEOE2408	NANO Technology and its Applications	3	0	0	3	40	60	100	OEC

CREDITS SUMMARY

S.NO	CATEGORY	CREDITS SUMMARY								TOTAL CREDITS	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1.	**HSMC**	4	3	-	-	-	-	5	-	12	7.88
2.	**BSC**	12	4	4	6	-	-	-	-	26	15.75
3.	**ESC**	5	9	12	-	-	-	-	-	26	15.75
4.	**PCC**	-	8	8	15	9	11	-	-	51	30.91
5.	**PEC**	-	-	-	-	6	3	6	3	18	10.90
6.	**OEC**	-	-	-	-	3	3	3	3	12	7.27
7.	**EEC**	1	2	-	-	2	2	2	10	19	11.51
8.	**MC**					√	√				
TOTAL		**22**	**26**	**24**	**21**	**20**	**19**	**16**	**16**	**164**	**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

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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.

VERTICAL FOR HONOURS

VERTICAL I – MEDICAL DEVICE INNOVATION AND DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	UBMPE2425	Foundation skills in integrated product development	PEC	3	0	0	3	3
2.	UBMPE2426	Medical Device Design	PEC	3	0	0	3	3
3.	UBMPE2427	Patient Safety, Standards and Ethics	PEC	3	0	0	3	3
4.	UBMPE2428	Medical Device Regulations	PEC	3	0	0	3	3
5.	UBMPE2429	Medical Innovation and Entrepreneurship	PEC	3	0	0	3	3
6.	UBMPE2430	Rapid Prototyping	PEC	3	0	0	3	3

VERTICAL II – BIOMEDICAL MECHANICS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	UBMPE2431	Biomechanics	PEC	3	0	3	4	3
2	UBMPE2432	Rehabilitation Engineering	PEC	3	0	0	3	3
3	UBMPE2433	Physiological Modelling	PEC	3	0	0	3	3
4	UBMPE2434	Assistive technology	PEC	3	0	0	3	3
5	UBMPE2435	Ergonomics	PEC	3	0	0	3	3
6	UBMPE2436	Haptics	PEC	3	0	0	3	3

VERTICAL III – BIOSIGNAL AND IMAGE

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PROCESSING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIO	CREDITS
				L	T	P		
1	UBMPE2437	Bio signal Processing	PEC	3	0	0	3	3
2.	UBMPE2438	Computer Vision for biomedical engineers	PEC	3	0	3	4	3
3.	UBMPE2439	Speech and Audio Signal Processing	PEC	3	0	0	3	3
4	UBMPE2440	Fundamentals of Healthcare Analytics	PEC	3	0	0	3	3
5	UBMPE2441	Brain Computer Interface and applications	PEC	3	0	0	3	3
6	UBMPE2442	Biometrics	PEC	3	0	0	3	3

VERTICALS FOR MINOR DEGREE
(In addition to all the vertical so for 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	Datamining 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

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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 anyone vertical of other programmes or from anyone of the following verticals)

VERTICAL1: FINTECH AND BLOCKCHAIN

S. NO.	COURSE CODE	COURSETITLE	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

VERTICAL2: ENTREPRENEURSHIP

S. NO.	COURSE CODE	COURSETITLE	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 Management for Business	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 Entrepreneurs	PEC	3	0	0	3	3
6.	UCMG2412	Financing New Business Ventures	PEC	3	0	0	3	3

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VERTICAL3: 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

VERTICAL4: BUSINESS DATA ANALYTICS

S. NO.	COURSE CODE	COURSETITLE	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

VERTICAL5: ENVIRONMENT AND SUSTAINABILITY

S. NO.	COURSE CODE	COURSETITLE	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

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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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THE KAVERY ENGINEERING COLLEGE

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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B
Mecheri, Salem Dt-636453, Tamilnadu

Department	S&H	Programme Code & Name	Common to All

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UENT24101	**PROFESSIONAL ENGLISH - I**	3	0	0	3	100
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 Joevani, 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	PSO 2	PSO 3
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

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMAT24102	**MATRICES AND CALCULUS**	3	1	0	4	100

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**

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UPHT24103	**ENGINEERING PHYSICS**	3	0	0	3	100
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**

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCHT24104	**ENGINEERING CHEMISTRY**	3	0	0	3	100
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, flouride 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:** H2-O2 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	PSO1	PSO1	PSO2
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**

Semester-I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UPST24105	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	3	0	0	3	100
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

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UTAT24106	**HERITAGE OF TAMIL**	1	0	0	1	100

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: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி –வைகை நதிக்கரையில்சங்ககாலநகரநாகரிகம் (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: 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 Thinai 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

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UTAT24106	தமிழர் மரபு	1	0	0	1	100

பாடநெறி நோக்கங்கள்	• சங்க இலக்கியத்தை புரிந்து **கொள்ளுதல்** • தமிழ் கலாச்சாரத்தின் பாரம்பரியத்தையும் மற்றும் பாறை ஓவியத்தின் **சிறப்பினையும்** கற்றுத் தெளி**தல்** • தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்பு கலை வடிவங்களை அங்கீகரிக்க**வும் 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 - சிற்றிலக்கியங்கள் –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, ஒயிலாட்டம். 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 அச்சு வரலாறு.		
Total No of Periods to be Taught	**Total: 15 periods**	

TEXT BOOK:	
1	தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி –வைகை நதிக்கரையில்சங்ககாலநகரநாகரிகம் (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)

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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	PSO1	PSO2
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**

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UPSL2413	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	0	0	4	2	100
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**

Semester I

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

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

Semester I

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

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

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 (TiO_2/ZnO/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**

Semester I

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UENL2411	**ENGLISH LABORATORY**	0	0	2	1	100
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	BME	Programme Code & Name	121 BE- BME

Semester II

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

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

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

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

COURSE OUTCOMES:

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

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

Mapping of COs with POs and PSOs

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

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

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

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMAT24201	**STATISTICS AND NUMERICAL METHODS**	3	1	0	4	100
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 derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Unit-V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**(9+3)**
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.		
Total No of Periods to be Taught	60 Periods	

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

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

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

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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	BME	**Programme Code & Name**	121 BE- BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24201	**BIOSCIENCES FOR MEDICAL ENGINEERING**	3	0	0	3	100
Course Objectives	• To study structural and functional properties of carbohydrates, proteins, lipids and amino acids • To emphasize the role of these biomolecules by providing basic information on specific • metabolic diseases and disorders of these biomolecules • Gain knowledge on the structural and functional aspects of living organisms. • Know the etiology and remedy in treating the pathological diseases.					

Unit-I	**FUNDAMENTALS TO BIOCHEMISTRY**	**(9)**
Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.		
Unit-II	**CARBOHYDRATES, LIPIDS, PROTEIN**	**(9)**
Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.		
Unit-III	**CELL DEGENERATION, REPAIR AND NEOPLASIA**	**(9)**
Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. 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-IV	**FLUID AND HEMODYNAMIC DERANGEMENTS**	**(9)**
Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders Bleeding disorders, Leukaemias, Lymphomas, Haemorrhage.		
Unit-V	**FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY**	**(9)**

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Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and virus - List of common bacterial, fungal and viral diseases of human beings.- Basics of Microscopes : Light microscope, Electron microscope (TEM & SEM). - Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury, Immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.	
Total No of Periods to be Taught	**45**

TEXT BOOK:	
1	RAFI MD "Text book of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021.
2	Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 10 th edition: South Asia Edition Elsevier India, 2020. (Units III & IV).
3	Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2017 10 th edition. (Units III,IV and V).

REFERENCES:	
1	Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2	Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
3	Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007
4	Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the fundamentals of biochemistry
CO2:	Analyze structural and functional aspects of living organisms.
CO3:	Explain the function of microscope
CO4:	Describe methods involved in treating the pathological diseases.
CO5:	Study the fundamentals of microbiology and immunology

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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	-	-	1	-	1	-	-	-	1	1	-
CO2	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO3	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO4	3	3	3	-	-	1	-	1	-	-	-	1	1	-
CO5	3	3	3	-	-	1	-	1	-	-	-	1	1	-
Avg.	3	3	2	-	-	1	-	1	-	-	-	1	1	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121 BE- BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24202	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3	100
Course Objectives	• To introduce the basics of electric circuits and analysis • To impart knowledge in the basics of working principles and application of electrical • machines • To introduce analog devices and their characteristics • To educate on the fundamental concepts of digital electronics • To introduce the functional elements and working of measuring instruments					

Unit-I	ELECTRICAL CIRCUITS	(9)
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Independent and Dependent Sources – 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)		
Unit-II	**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-III	**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		
Unit-IV	**DIGITAL ELECTRONICS**	**(9)**
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).		
Unit-V	**MEASUREMENTS AND INSTRUMENTATION**	**(9)**
Functional elements of an instrument, Standards and calibration, Operating Principle , types Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT,DSO- Block diagram- Data acquisition.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2	. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3	Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4	James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015

REFERENCES:	
1	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2	Thomas L. Floyd, 'Digital Fundamentals', 11 th Edition, Pearson Education, 2017
3	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7 th edition, 2017.
4	Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
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 working principle and applications of electrical machines
CO3:	Analyze the characteristics of analog electronic devices
CO4:	Explain the basic concepts of digital electronics
CO5:	CO5: Explain the operating principles of measuring instruments

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121 BE- BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UPHT24206	**MEDICAL PHYSICS**	3	0	0	3	100
Course Objectives	• To provide understanding of the application of the radiation concepts and methods of Physics in Medical science • To accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation. • To enunciate the fundamentals of acoustic waves and their interaction with human tissues. • To explore the effects of radiation in matter and how isotopes are produced • To study effects of sound and light in human body					

Unit-I	LOW ENERGY ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL APPLICATION	(9)
Physics of light, Intensity of light, limits of vision and color vision an overview, Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Tissue as a leaky dielectric-Low Frequency Effects- Higher frequency effects., Thermography– Application.		
Unit-II	**PRINCIPLES OF RADIOACTIVE NUCLIDES**	**(9)**
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology, Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radionuclide-fission and neutron capture reaction, radionuclide Generator-Technetium generator		
Unit-III	**INTERACTION OF RADIATION WITH MATTER LIPIDS**	**(9)**
Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.		
Unit-IV	**RADIATION DOSE AND ITS EFFECTS**	**(9)**
Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the dosimetric quantities, Radiation biology – effects of radiation, concept of LD 50, Stochastic and Non-stochastic effects, Radiation Syndrome.		
Unit-V	**PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE**	**(9)**
Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, D.R. Hose, "Medical Physics and Biomedical Engineering", Institute of physics publishing, Bristol and Philadelphia, 1999.
2	2. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine" Fourth edition Springer, 2006.

REFERENCES:	
1	W.J. Meredith and J.B. Massey "Fundamental Physics of Radiology" Varghese Publishing house, Third Edition, 2013.
2	Steve Webb, The Physics of Medical Imaging, Taylor & Francis, Newyork, Second Edition, 2012.
3	R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
4	http://www.nptel.ac.in/courses/115102017/ , "Nuclear science and Engineering", Dr. Santanu Gosh, Department of Physics, IIT, Delhi.
5	http://www.uthgsbsmedphys.org/GS02-0093/ ," Introduction to Medical Physics", Dr George Starkschall, The University of Texas at Houston.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Interpret the properties of electromagnetic radiations and its effect on human.
CO2:	Apply the principles and understand the production of radioactive nuclides.
CO3:	Explain the interaction of radiation with matter.
CO4:	Identify and Analyse the radiation quantities and its effects
CO5:	Demonstrate the knowledge on the properties of sound and its application in medicine.

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

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

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Department	BME	**Programme Code & Name**	121 - B.E BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24201	**ENGINEERING GRAPHICS**	2	0	4	4	100

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	BME	Programme Code & Name	121 BE- BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UTAT24201	தமிழரும் தொழில் நுட்பமும்	1	0	0	1	100
பாடநெறி நோக்கங்கள்	• நெசவு மற்றும் **பானை** 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** பயன்**பாட்டையும் கற்றல்**					

அலகு 1	நெசவுமற்றும்பானைத்தொழில்நுட்பம்	(3)

சங்ககாலத்தில் நெசவுத்தொழில், பானைத்தொழில்நுட்பம், 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 குமுழித் 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**

TEXT BOOK:	
1	தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர் இல, சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி –வைகை நதிக்கரையில்சங்ககாலநகரநாகரிகம் (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 **பானை** 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** பயன்**பா**டுகளின் 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	BME	Programme Code & Name	121- BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGEL24201	ENGINEERING PRACTICES LABORATORY	0	0	4	2	100
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**



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	BME	**Programme Code & Name**	121 BE- BME

Semester II

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24201	BIOSCIENCES LABORATORY	0	0	4	2	100
Course Objectives	• Estimation and quantification of biomolecules. • Separation of macromolecules. • Use Compound microscope • Practice on chemical examinations, Histopathological examinations etc.					

List of Exercises/Experiments	
1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions	
2. Standardization of pH meter, preparation of buffers, emulsions.	
3. Spectroscopy: Determination of absorption maxima (λmax) of a given solution	
4. General tests for carbohydrates, proteins and lipids.	
5. Identification of Blood Collection Tubes and Phlebotomy equipment	
6. Preparation of serum and plasma from blood	
7. Estimation of Haemoglobin and blood glucose	
8. Estimation of creatinine, urea and Uric acid	
9. Separation of proteins by SDS electrophoresis (Demo) and amino acids by thin layer chromatography (Demo).	
10. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)	
11. Basic staining – Hematoxylin and eosin staining.	
12. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS	
13. Types of Staining: Simple stain, Gram stain	
14. Study of parts of compound microscope	
15. Study of Histopathological slides of benign and malignant tumours	
16. Study of Haematology slides of anemia and leukemia.	
Total No of Periods to be Taught	**60**

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TEXT BOOK:	
1	Ramnik Sood, Textbook of Medical Laboratory Technology, 6 Edition, Jaypee Brothers Medical Publishers, 2009

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the Biochemistry laboratory functional components
CO2:	Have a sound knowledge of qualitative test of different biomolecules.
CO3:	Understand the basics knowledge of Biochemical parameter and their interpretation in Blood sample.
CO4:	Have a sound knowledge of separation technology of proteins and amino acids.
CO5:	Student can perform practical experiments on staining Processes.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Colorimeter	1 No.
2	Spectrophotometer	2 Nos
3	pH meter	1 No.
4	Weighing balance	1 No
5	Refrigerator	1 No
6	SDS gel electrophoresis	1 No
7	TLC, ready TLC plates	1 No
8	Wintrobe's tube	1 No
9	Centrifuge Normal	2 Nos
10	Microslides	1 No
11	Lancet	2 packets
12	Microscope	5 boxes
13	Neubaur's Chamber	1 No
14	Heparinized Syringe	2 Nos
15	Haemoglobinometer	1box
16	Capillary tubes	1 No

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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	-	-	1	-	1	-	-	-	1	1	-
CO2	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO3	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO4	3	3	3	-	-	1	-	1	-	-	-	1	1	-
CO5	3	3	3	-	-	1	-	1	-	-	-	1	1	-
Avg.	3	3	2	-	-	1	-	1	-	-	-	1	1	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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

Semester II

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

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

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

Mapping of COs with POs and PSOs

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

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

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Mecheri, Salem Dt-636453, Tamilnadu

Department	BME	**Programme Code & Name**	121- B.E BME

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMAT24301	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	3	1	0	4	100
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)**
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.		
Unit-V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**(9+3)**
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
Total No of Periods to be Taught	**60 Periods**	

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

REFERENCES:	
1	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3	James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
4	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

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	-	-	-
CO2	3	3	1	1	0	0	0	2	0	0	3	-	-	-
CO3	3	3	1	1	0	0	0	2	0	0	3	-	-	-
CO4	3	3	1	1	0	0	0	2	0	0	3	-	-	-
CO5	3	3	1	1	0	0	0	2	0	0	3	-	-	-
Avg.	3	3	1	1	0	0	0	**2**	0	0	**3**	-	-	-

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

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

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24301	**FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS**	3	0	0	3	100
Course Objectives	• Introduce the concept of diodes, Bipolar Junction Transistors and FET. • Study the various model parameters of Transistors • Learn the concept of special semiconductor devices, Power & Display devices • Impart the knowledge of various configurations, characteristics, applications. • To have knowledge of display and power devices.					

Unit-I	**SEMICONDUCTOR DIODE**	**(9)**
PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.		
Unit-II	**BIPOLAR JUNCTION TRANSISTORS**	**(9)**
NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - h-parameter model, Ebers Moll Model- Multi Emitter Transistor.		
Unit-III	**FIELD EFFECT TRANSISTORS**	**(9)**
MOSFETs – Drain and Transfer characteristics, -Current Equations-Pinch off voltage and its significance-Threshold voltage -Channel length modulation, small signal Characteristics, D- MOSFET, E-MOSFET-Characteristics – Comparison of MOSFET with BJT.		
Unit-IV	**SPECIAL SEMICONDUCTOR DEVICES**	**(9)**
Metal-Semiconductor Junction - MESFET, Point Contact Diode, p-i-n Diode, Avalanche Photodiode, Schottky barrier diode- Zener diode- Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.		
Unit-V	**POWER DEVICES AND DISPLAY DEVICES**	**(9)**
UJT, Thyristor - SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Opto Coupler, Solar cell, CCD.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1.	Millman and Halkias, "Electronic Devices and Circuits", 4th Edition, McGraw Hill, 2015.
2.	Mohammad Rashid, "Electronic Devices and Circuits", Cengage Learning Pvt. Ltd, 2015.
REFERENCES:	
1.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Prentice Hall, 11th Edition, 2014.
2.	Bhattacharya and Sharma, "Solid State Electronic Devices", 2nd Edition, Oxford University Press, 2014.
3.	R.S.Sedha, "A Textbook of Electronic Devices and Circuits", 2nd Edition, S.Chand Publications, 2008.
4.	David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Analyze the characteristics of semiconductor diodes.
CO2:	Analyze and solve problems of Transistor circuits using model parameters.
CO3:	Identify and characterize diodes and various types of transistors.
CO4:	Analyze the characteristics of special semiconductor devices.
CO5:	Analyze the characteristics of Power and Display devices.

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

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24302	**ELECTRIC CIRCUIT ANALYSIS**	3	0	0	3	100
Course Objectives	• To introduce the basic concepts of DC and AC circuits behavior • To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations. • To introduce different methods of circuit analysis using Network theorems, duality and topology.					

Unit-I	**BASIC CIRCUITS ANALYSIS**	**(9)**
Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Laws, Mesh current and node voltage method of analysis for D.C. The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.		
Unit-II	**NETWORK THEOREM AND DUALITY**	**(9)**
Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, application of Network theorems. Network reduction: voltage and current division, Duals, Dual circuits.		
Unit-III	**SINUSOIDAL STEADY STATE ANALYSIS**	**(9)**
Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.		
Unit-IV	**TRANSIENTS AND RESONANCE IN RLC CIRCUITS**	**(9)**
Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.		
Unit-V	**COUPLED CIRCUITS AND TOPOLOGY**	**(9)**
Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis.		
Total No of Periods to be Taught	**45**	
TEXT BOOK:		

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1	Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2	Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1.	Robert. L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.
2.	John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.
3.	Charles.K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.
4.	Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

COURSE OUTCOMES:
On completion of the course, the students will be able to

CO1:	Comprehend and design ac/dc circuits.
CO2:	Apply circuit theorems in real time.
CO3:	Evaluate ac/dc circuits.
CO4:	Analyse the electrical circuits.
CO5:	Develop and understand ac/dc circuits.

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

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

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCST24302	**OBJECT ORIENTED PROGRAMMING**	L	T	P	C	100
		3	0	0	3	
Course Objectives	• To understand Object Oriented Programming concepts and basics of Java programming language • To know the principles of packages, inheritance and interfaces • To develop a java application with threads and generics classes To define exceptions and use I/O streams • To design and build Graphical User Interface Application using JAVAFX					

Unit-I	**INTRODUCTION TO OOP AND JAVA**	**(9)**
Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifies - Static members- Java Doc comments.		
Unit-II	**INHERITANCE, PACKAGES AND INTERFACES**	**(9)**
Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.		
Unit-III	**EXCEPTION HANDLING AND MULTITHREADING**	**(9)**
Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.		
Unit-IV	**I/O, GENERICS, STRING HANDLING**	**(9)**
I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.		
Unit-V	**JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS**	**(9)**
JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – Scroll Pane. Layouts – Flow Pane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.		

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Total No of Periods to be Taught	**45**

TEXT BOOK:	
1	Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019
2	Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, New Delhi, 2015

REFERENCES:	
1	Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Apply the concepts of classes and objects to solve simple problems
CO2:	Develop programs using inheritance, packages and interfaces
CO3:	Make use of exception handling mechanisms and multithreaded model to solve real world problems
CO4:	Build Java applications with I/O packages, string classes, Collections and generics concepts
CO5:	Integrate the concepts of event handling and JavaFX components and controls for developing GUI based 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	1	1	1	-	-	-	-	-	-	-	1	-
CO2	3	3	1	1	1	-	-	-	-	-	-	-	1	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	1	-
CO4	3	3	1	2	1	-	-	-	-	-	-	-	1	-
CO5	3	3	1	2	1	-	-	-	-	-	-	-	1	-
Avg.	**3**	**3**	**1**	**1**	**1**	-	-	-	-	-	-	-	**1**	-

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

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

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMTL24301	**ANATOMY AND HUMAN PHYSIOLOGY**	3	0	2	4	100
Course Objectives	• To integrate the individual functions of all the cells and tissues and organs into functional whole, the human body. • Function is dependent on a structure, the curriculum lays stress on functional anatomy of the organs. • Emphasizes on the cardiovascular, respiratory, urinary and nervous system and their interrelatedness. • Stimulate the students to understand the basic functioning of every system and the resultant unified organization.					

Unit-I	**BASIC ELEMENTS OF HUMAN BODY**	**(9)**
Cell – Cell Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane - Action potential, Homeostasis. Tissue: Types, functions.		
Unit-II	**SKELETAL AND RESPIRATORY SYSTEM**	**(9)**
Skeletal system: Bone types and functions, Mechanism of bone formation– Joint - Types of Joint - Cartilage and functions. Respiratory System: Components of respiratory system – Respiratory Mechanism, Lung volumes and capacities – Gaseous exchange.		
Unit-III	**CARDIOVASCULAR SYSTEM**	**(9)**
Cardiovascular System: Structure – Conduction System of heart – Cardiac Cycle – Cardiac output. Blood: Composition – Functions - Haemostasis – Blood groups and typing. Blood Vessels – Structure and types – Regulation of Blood pressure		
Unit-IV	**DIGESTIVE AND EXCRETORY SYSTEMS**	**(9)**
Structure and functions of gastrointestinal system - secretory functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - Structure of Kidney and Nephron - Mechanism of Urine formation and acid base regulation.		
Unit-V	**NERVOUS AND SENSORY SYSTEM**	**(9)**
Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential in neuron. Brain – Divisions of brain lobes – Spinal cord – Tracts of spinal cord - Reflex mechanism – Somatic and Autonomic Nervous system. Special senses: Eye and Ear.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Ninth Edition, Pearson Education, New Delhi, 2018.
2	Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine", Third edition Springer, 2006. (Unit 2,3,4)

REFERENCES:	
1	Guyton & Hall, "Text book of Medical Physiology", 13th Edition, Saunders, 2015.
2	Ranganathan T S, "Text book of Human Anatomy", S.Chand& Co. Ltd., New Delhi, 2012.
3	Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", S. Chand and Company Ltd, New Delhi, 2012.

List of Exercises/Experiments	
1. Collection of Blood Samples	
2. Identification of Blood groups (Forward and Reverse)	
3. Bleeding and Clotting time	
4. Estimation of Hemoglobin	
5. Total RBC and WBC Count	
6. Differential count of Blood cells	
7. Estimation of ESR, PCV, MCH, MCV, MCHC	
8. Hearing test – Tuning fork	
9. Visual Activity – Snellen's Chart and Jaeger's Chart	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Identify and explain basic elements of human body
CO2:	Explain the functions of skeletal and muscular system
CO3:	Describe the structure, function of cardiovascular system and respiratory system
CO4:	Discuss the structure of digestive and excretory system
CO5:	Describe the physiological process of Nervous and sensory system

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	Microscope	2 Nos
2	Wintrobe's tube	2 Nos
3	PCV tube	2 Nos
4	Neubaur's Chamber	2 Nos
5	Heparinized Syringe	1 Box
6	Haemoglobinometer	1 No
7	Blood grouping kit	1 No
8	Capillary tubes	1 Box
9	Ophthalmoscope	1 No
10	Tuning fork (256Hz to 512Hz)	5 Nos
11	Micro slides	2 Packets
12	Lancet	5 Boxes

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	1	-	-
CO2	3	3	2	-	-	1	1	-	-	-	1	1	-	-
CO3	3	3	2	-	-	1	1	-	-	-	1	1	-	-
CO4	3	3	3	-	-	1	1	-	-	-	1	1	-	-
CO5	3	3	3	-	-	1	1	-	-	-	1	1	-	-
Avg.	3	3	2	-	-	1	1	-	-	-	1	1	-	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	BME	**Programme Code & Name**	BE- BME

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMTL24302	**SENSORS AND MEASUREMENTS**	3	0	2	4	100
Course Objectives	• To understand the purpose of measurement, the methods of measurements, errors associated with measurements. • To know the principle of transduction, classifications and the characteristics of different transducers • To learn the different bridges for measurement. • To know the different display and recording devices. • To understand various type of biosensors.					

Unit-I	**FUNDAMENTALS OF MEASUREMENTS**	**(9)**
Measurement System – Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis- methods of error analysis,- uncertainty analysis-expression of uncertainty: accuracy and precision index, propagation of errors– Calibration - Primary and secondary standards.		
Unit-II	**DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS**	**(9)**
Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.		
Unit-III	**PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS**	**(9)**
Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.		
Unit-IV	**SIGNAL CONDITIONING CIRCUITS AND METERS**	**(9)**
Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q- meter, PMMC, MI.		
Unit-V	**RECORDING DEVICES AND ADVANCED SENSORS**	**(9)**
CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation",10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2	John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015

REFERENCES:	
1	Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, New Delhi, 2014.
2	Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
3	Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1st edition, 2016.

List of Exercises/Experiments	
1. Calibration of voltmeter and ammeter using shunt type Potentiometer	
2. Characteristics of thermistor	
3. Characteristics of thermocouple	
4. Characteristics of LDR	
5. Characteristics of Photo Diode	
6. Characteristics of Photo transistor	
7. Characteristics of RTD	
8. Characteristics of LVDT	
9. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone bridge	
10. Measurement of unknown Capacitance using Schering Bridge	
11. Measurement of unknown Inductance using Maxwell's & Hay's Bridge	
12. Characteristics of Hall effect transducer	
13. Characteristics of strain gauge	
14. Demonstration of CRO & DSO	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Measure various electrical parameters with accuracy, precision, resolution.
CO2:	Select appropriate passive or active transducers for measurement of physical phenomenon.
CO3:	Select appropriate light sensors for measurement of physical phenomenon

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CO4:	Use AC and DC bridges for relevant parameter measurement.
CO5:	Employ multimeter, CRO and different types of recorders for appropriate measurement.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	Thermocouple	5 Nos
2	RTD	5 Nos
3	Strain Gauge (bonded and unbounded type)	5 each
4	Photo transistor, photodiode	5 Nos/each
5	Resistors-Range between1-0.0001ohm	10 Nos/each
6	CRO	8 No
7	DSO	3 Nos
8	LVDT	5 Nos
9	Piezoelectric Transducer	5 Nos
10	Potentiometer, Thermistor, LDR	5 Nos
11	Trainer kits- Schering Bridge, Maxwell's bridge, Hay's bridge,	1No each
12	Gas sensor	3 Nos
13	Piezoelectric Transducer	5 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	3	2	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	1	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	-	-
Avg.	3	3	2	1	-	-	-	-	-	-	-	1	-	-

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

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Department	BME	**Programme Code & Name**	121-BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24301	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS LABORATORY	0	0	3	1	100
Course Objectives	• To supplement the theory courses Semiconductor Devices and Basic Electrical Engineering. • To assist the students in obtaining a better understanding of the operation of electronic circuits and devices. • To provide experience in analysing network theorems.					

List of Exercises/Experiments	
1. Characteristics of PN and Zener diode.	
2. Characteristics of CE, CB configurations.	
3. Half wave and Full wave rectifier with capacitor filter.	
4. Voltage regulation using zener diode.	
5. Study of characteristics of photo diodes	
6. Study of characteristics of SCR	
7. Verification of KVL and KCL	
8. Verification of Thevenin's and Norton's Theorems.	
9. Verification of superposition Theorem.	
10. Verification of Maximum power transfer and reciprocity theorems.	
11. Frequency response of RLC series and parallel resonance circuits.	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Experiment and determine the VI characteristics of given PN junction diode, Zener diode, Photo diode and Silicon Controlled Rectifier.
CO2:	Experiment and determine the Input & output characteristics of BJT
CO3:	Experiment and test half wave and full wave rectifier circuit using PN Junction diode and obtain the ripple factor, rectifier efficiency and experiment and test voltage regulation characteristics using Zener diode voltage regulator circuit

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CO4:	Experiment and test the given electric circuit using Kirchhoff's laws and obtain the mesh current & node voltage and obtain the load current for the given circuit using Superposition, Thevenin's, and Norton's and Reciprocity theorems.
CO5:	Construct and test RLC series and parallel circuits to compute the resonant frequency and bandwidth by plotting the frequency response.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	CRO 30MHz	10
2	DC Digital Ammeter	02
3	DC Digital Voltmeter	02
4	Function Generator(3MHz)	10
5	Analog IC Tester	01
6	Digital IC Tester	01
7	Digital IC TrainerKit	10
8	Dual Regulated Power supply (0-30) V/2A	10
9	Multiple Regulated Power suppy(+5)V/2A,(015)V/2A	10
10	Single Regulated Power supply (0-30) V/2A	05
11	Variable Resistance Box(6Dial)	05
12	Decade Inductance Box(6Dial)	05
13	Decade Capacitance Box (6Dial)	05
14	Analog Ammeter(0-1)mA, (0-10)mA, (0-100)mA, (0-200)µA	Each 10
15	Analog Voltmeter(0-5)V, (0-10)V, 0-100mV	Each 10
16	Digital Multimeter	03
17	Transformer(9-0-9)V	04
18	IC-BC107, BC148, 2N2646, BFW10,I N4007	Each 25
19	Zener diode, Resistor, Capacitor, Inductors	Each 25
20	Bread Board	15
21	Photodiode and SCR	Each 20

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
UCSL24302	**OBJECT ORIENTED PROGRAMMING LABORATORY**	L 0	T 0	P 3	C 1	100
Course Objectives	• To build software development skills using java programming for real-world applications. • To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing. • To develop applications using generic programming and event handling					

List of Exercises/Experiments
1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area ( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads.
8. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
9. Write a program to perform file operations.
10. Develop applications to demonstrate the features of generics classes.

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11. Develop applications using Java FX controls, layouts and menus.
12. Develop a mini project for any application using Java concepts.

Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Design and develop java programs using object-oriented programming concepts
CO2:	Develop simple applications using package, exceptions, multithreading, and generics concepts
CO3:	Create GUIs and event driven programming applications for real world problems
CO4:	
CO5:	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2	Windows 10 or higher operating system / Linux / Windows Front End Tools: Eclipse IDE / Netbeans IDE	30
3	Standalone desktops PC	15 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	3	1	1	1	-	-	-	1	1	-	-	1	1
CO2	3	3	1	1	1	-	-	-	1	1	-	-	1	1
CO3	3	3	1	1	1	-	-	-	1	1	-	-	1	1
CO4	3	3	1	1	1	-	-	-	1	1	-	-	1	1
CO5	3	3	1	1	1	-	-	-	1	1	-	-	1	1
Avg.	3	3	1	1	1	-	-	-	1	1	-	-	1	1
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	BME	**Programme Code & Name**	121 - B.E- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
USD24301	SOFT SKILL 1	2	0	0	0	100

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/arithmetic-aptitude-questions-answers
3	https://prepinsta.com

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Practice manners and etiquettes in day-to-day life.
CO2:	Be confident and motivated to plan the activities according to personality types.
CO3:	Build Confidence in Mathematics.
CO4:	Solve mathematical problems by applying logical thinking.
CO5:	Apply different techniques for faster calculations.

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMAT24305	RANDOM PROCESSES AND LINEAR ALGEBRA	3	1	0	4	100
Course Objectives	• To introduce the basic notions of vector spaces which will then be used to solve related problems. • To understand the concepts of vector space, linear transformations, inner product spaces and orthogonalization. • To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering. • To provide necessary basics in probability that are relevant in applications such as random signals, linear systems in communication engineering. • To understand the basic concepts of probability, one and two dimensional random • Variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.					

Unit-I	PROBABILITY AND RANDOM VARIABLES	(9+3)
Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.		
Unit-II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**(9+3)**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).		
Unit-III	**RANDOM PROCESSES**	**(9+3)**
Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions.		
Unit-IV	**VECTOR SPACES**	**(9+3)**
Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.		
Unit-V	**LINEAR TRANSFORMATION AND INNER PRODUCT SPACES**	**(9+3)**
Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Inner product - Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.		

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Total No of Periods to be Taught	**60**

TEXT BOOK:	
1	Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2	Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.

REFERENCES:	
1	Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2	Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3	Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
4	Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
CO2:	Demonstrate accurate and efficient use of advanced algebraic techniques. Apply them to model engineering problems.
CO3:	Apply the concept of random processes in engineering disciplines.
CO4:	Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.
CO5:	Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

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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	0	0	0	0	0	3	0	0	2	-	-	-
CO2	3	3	0	0	0	0	0	3	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	3	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	3	0	0	2	-	-	-
CO5	3	3	0	0	0	0	0	3	0	0	2	-	-	-
Avg.	3	3	0	0	0	0	0	3	0	0	2	-	-	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121-BE- BME

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24401	BIOMEDICAL INSTRUMENTATION	3	0	0	3	100
Course Objectives	• To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements. • To understand the characteristics of Bio signals. • To understand the design of bio amplifiers. • To explain the different techniques used for measurement of non-electrical bio-parameters • To explain the biochemical measurement techniques as applicable for diagnosis and treatment.					

Unit-I	ELECTRODE CONFIGURATIONS	(9)
Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface, polarization effects of electrode – non-polarizable electrodes, classification of electrodes.		
Unit-II	**BIOSIGNAL CHARACTERISTICS**	**(9)**
Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system. EMG– unipolar and bipolar mode.		
Unit-III	**BIOAMPLIFIERS**	**(9)**
Need for bio-amplifier - Differential bio-amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation. Chopper amplifier. Power line interference		
Unit-IV	**MEASUREMENT OF BIO SIGNALS**	**(9)**
Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods. Blood flow measurement- Electromagnetic and ultrasound blood flow measurements. Cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method.		
Unit-V	**BIOCHEMICAL MEASUREMENTS**	**(9)**
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET). Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2	John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.

REFERENCES:	
1	John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
2	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Illustrate the origin of various biological signals and their characteristics
CO2:	Gain knowledge on characteristics of bio signals.
CO3:	Gain knowledge on various amplifiers involved in monitoring and transmission of biosignals
CO4:	Explain the different measurement techniques for non-electrical bio-parameters
CO5:	Explain the biochemical measurement techniques as applicable for diagnosis and further treatment

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24402	ANALOG AND DIGITAL INTEGRATED CIRCUITS	3	0	0	3	100
Course Objectives	• To study the circuit configuration and introduce practical applications of linear integrated circuits. • To introduce the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications. • To introduce the design of various combinational digital circuits using logic gates • To bring out the analysis and design procedures for synchronous and asynchronous sequential circuits					

Unit-I	INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS	(9)
Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters.		
Unit-II	**DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL**	**(9)**
Introduction to D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator. PLL-Closed loop analysis of PLL.		
Unit-III	**THE BASIC GATES AND COMBINATIONAL LOGIC CIRCUITS**	**(9)**
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s es, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map and Tabulation methods. Comparison of Logic families.		
Unit-IV	**COMBINATIONAL LOGIC CIRCUITS**	**(9)**
Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux.		
Unit-V	**SEQUENTIAL LOGIC CIRCUITS**	**(9)**
lip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, and circuit implementation. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Mc Graw Hill Education, 3rd Edition, 2017
2	John.F.Wakerly, "Digital design principles and practices", Pearson Education, 5th Edition, 2018

REFERENCES:	
1	Taub and Schilling, "Digital Integrated Electronics", Mc Graw Hill, 2017.
2	Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013
3	M. Morris Mano and Michael D.Ciletti, "Digital Design", Pearson, 5th Edition, 2013
4	S Salivahanan and V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education, 3rd Edition, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Design new analog linear circuits and develop linear IC based Systems.
CO2:	Apply the concept of ADC and DAC in real time systems and Phase Locked Loop with applications.
CO3:	Use Boolean algebra and apply it to digital systems.
CO4:	Design various combinational digital circuits using logic gates.
CO5:	Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

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

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

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

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24403	**BIO CONTROL SYSTEMS**	3	0	0	3	100
Course Objectives	• Understand the concept behind feedback and continuum in various systems and subsystems and the need for mathematical modelling of various systems. • Analyze the systems in time and frequency domains • Understand the concept of stability of various systems. • Apply mathematical modeling principles in understanding the various fundamental biological systems.					

Unit-I	**INTRODUCTION**	**(9)**
Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.		
Unit-II		**(9)**
Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.		
Unit-III		**(9)**
Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability.		
Unit-IV		**(9)**
Frequency domain specifications - Polar plots - Bode plots - Nyquist plot - Nyquist stability criterion, closed loop stability - Nichol's chart.		
Unit-V		**(9)**
Simple models of muscle stretch reflex action - steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	I.J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1st September, 2018.
2	Michael C K Khoo, Physiological Control Systems, IEEE Press, Prentice Hall India, 2005.

REFERENCES:	
1	Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control
2	Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3	Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice- Hall, 2002.
4	**ONLINE RESOURCES** 1. https://nptel.ac.in/courses/108/101/108101037/ 2. https://nptel.ac.in/content/storage2/courses/112104158/lecture14.pdf 3. https://nptel.ac.in/content/storage2/courses/112104158/lecture16.pdf

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Interpret the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems
CO2:	Determine the time response of various systems
CO3:	Discuss the concept of system stability
CO4:	Examine the frequency response characteristics of various systems using different charts
CO5:	Appraise the concept of modeling basic physiological 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	2	2	-	-	-	-	-	-	-	2	1	1
CO2	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO3	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO4	3	2	2	2	1	-	-	-	-	-	-	2	1	1
CO5	3	2	2	2	1	-	-	-	-	-	-	2	1	1
Avg.	**3**	**2**	**2**	**2**	**1**	-	-	-	-	-	-	2	1	1

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UESST24401	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	2	0	0	2	100

Course Objectives

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

Unit-I	ENVIRONMENT AND BIODIVERSITY	(9)

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		(9)

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	(9)

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	(9)

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

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Unit-V	SUSTAINABILITY PRACTICES	(9)
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	**45**	

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.

REFERENCES:	
1	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013

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	-	-	-	3	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	-	-	-	-	2	-	-	-
CO3	3	-	1	-	-	2	-	-	-	-	2	-	-	-
CO4	3	2	1	1	-	2	-	-	-	-	2	-	-	-
CO5	3	2	1	-	-	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1	1	-	2.4	-	-	-	-	1.8	-	-	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMTL24401	**SIGNAL PROCESSING**	3	0	2	4	100
Course Objectives	• To understand about the continuous time and discrete time signals and systems. • To learn the analysis of LTI systems using Laplace and Z transform. • To represent the signal in frequency domain using FFT. • To gain knowledge about the design of IIR and FIR filters.					

Unit-I	**FUNDAMENTALS OF SIGNALS AND SYSTEMS**	**(9)**
Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.		
Unit-II	**ANALYSIS OF LTI SYSTEMS**	**(9)**
Analysis of Continuous Time LTI Systems - Z Transform - Properties of ROC– Inverse Z Transform – DTFT - Analysis of Discrete Time LTI Systems.		
Unit-III	**DISCRETE FOURIER TRANSFORM**	**(9)**
DFT and its properties, magnitude and phase representation-Linear Convolution- Correlation- Circular Convolution, Overlap-add and overlap-save methods. FFT - Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering		
Unit-IV	**INFINITE IMPULSE RESPONSE FILTERS**	**(9)**
Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade and parallel forms		
Unit-V	**FINITE IMPULSE RESPONSE FILTERS AND MULTIRATE SIGNAL PROCESSING**	**(9)**
Design of linear phase FIR filters – windowing- LPF/HPF/BPF (Hamming, Hanning, Blackman)- and Comparison of FIR and IIR. Introduction to DSP processors. Introduction to Multirate signal Processing – Decimation and Interpolation.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2nd Edition, 2015.
2	John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, 4 th Edition, 2014.

REFERENCES:	
1	S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2 nd Edition, 2007
2	B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.
3	Emmanuel Ifeachor, Barrie Jervis, "Digital Signal Processing- A practical approach", Pearson, 2 nd Edition, 2002
	M. H. Hayes, "Digital Signal Processing, Schaum's outlines", Tata McGraw Hill, 2nd Edition, 2011.

List of Exercises/Experiments	
1. Construction of signals with different Frequencies.	
2. Analyse the stability of a CT System with various inputs.	
3. Analyse the stability of a DT System with various inputs.	
4. Reconstruct a signal from samples and study the effect of Aliasing.	
5. Spectrum Analysis using FFT	
6. Filter Design & Analysis.	
7. Finite word length effect.	
8. Multirate Signal Processing.	
9. DSP Processor Implementation. (Linear and Convolution, FFT implementation, IIR and FIR filters implementation)	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	To classify the continuous time and discrete time signals and systems.
CO2:	To analyze the signals in both continuous time and discrete time
CO3:	To apply DFT for the analysis of digital signals & system
CO4:	To design IIR filter to process real world signals.
CO5:	To design FIR filter to process real world signals.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	Computers with simulation softwares/ Equivalent software	15 Numbers
2	TMS320C5416 Processors	5 Numbers

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

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

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

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24401	**BIOMEDICAL INSTRUMENTATION LABORATORY**	0	0	2	1	100
Course Objectives	To provide hands on training on Measurement of physiological parameters, biochemical parameters measurement and bio signal analysis.					

List of Exercises/Experiments	
1. Design and analysis of biological preamplifiers	
2. Recording of ECG signal and analysis	
3. Recording of EMG-Signal	
4. Recording of EEG-Signal	
5. Measurement of pulse rate using photo transducer	
6. Measurement of pH and conductivity.	
7. Measurement and recording of peripheral blood flow	
8. Measurement of blood pressure using sphygmomanometer	
9. Study of characteristics of optical Isolation amplifier	
10. Galvanic skin resistance (GSR)measurement	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Design the amplifier for Bio signal measurements
CO2:	Measure heart rate and heart sounds.
CO3:	Record and analyze pulse rate and respiration rate
CO4:	Measure blood pressure and blood flow
CO5:	Design isolation amplifier

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	pH meter and conductivity meter	1 No
2	Photo transducer for pulse measurement	1 No
3	Sphygmomanometer and Stethoscope	1 No
4	Blood flow measurement system	1 No
5	Multiparameter (ECG, EMG, EEG) Simulator	2 No
6	Function generator, DSO, Regulated Power supplies, Bread boards	5 each
7	IC 741	25 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	3	1	1	1	1	-	1	1	1	-	1	-	-
CO2	3	3	1	1	1	1	-	1	1	1	-	1	-	-
CO3	3	3	1	1	1	1	-	1	1	1	-	1	-	-
CO4	3	3	1	1	1	1	-	1	1	1	-	1	-	-
CO5	3	3	1	1	1	1	-	1	1	1	-	1	-	-
Avg.	**3**	**3**	**1**	**1**	**1**	**1**	-	**1**	**1**	**1**	-	**1**	-	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24402	**ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY**	0	0	2	1	100
Course Objectives	• To design digital logic and circuits • To learn the function of different ICs • To understand the applications of operation amplifier. • To learn the working of multivibrators • To design circuits for generating waveforms using ICs					

List of Exercises/Experiments	
1. Inverting, non-inverting amplifier and comparator	
2. Integrator and Differentiator	
3. Design and analysis of active filters using opamp	
4. Schmitt trigger using operational amplifier	
5. Instrumentation amplifier using operational amplifier	
6. RC and LC oscillators	
7. Study of logic gates, Half adder and Full adder	
8. Encoder and BCD to 7 segment decoder	
9. Multiplexer and demultiplexer using digital ICs	
10. Universal shift register using flip flops	
11. Simulation and analysis of circuits using software	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES:
On completion of the course, the students will be able to

CO1:	Design Combinational Circuits using logic gate
CO2:	Design and implement arithmetic circuits for different applications using opamp
CO3:	Design Sequential Circuits using logic gates
CO4:	Design wave form generators and analyse their characteristics
CO5:	Simulate and analyse circuits using ICs

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	Digital Trainer Kit	10 Nos
2	Logic ICs-(7400,7402,7404,7408,7410,7420,7432,7447,7448,7474, 7476,7483,,7485,7486,7490,7495,74151,741CommonAnode andcathode7-segmentdisplays,LEDs)	Each 25 Nos
3	NE555	25 nos
4	LM317andLM723	Each 10 Nos
5	Resistors	50 nos
6	Capacitors	50 nos
7	Dual power supply	10 Nos
8	Breadboards	15 Nos
9	IC741	30 Nos
10	CRO, DSO, Function Generator	10 Nos
11	DSO	5 Nos
12	Circuit Simulation Software	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	1	1	1	-	-	1	1	-	-	1	-	-
CO2	3	3	1	1	1	-	-	1	1	-	-	1	-	-
CO3	3	3	1	1	1	-	-	1	1	1	-	1	-	-
CO4	3	3	1	1	1	-	-	1	1	1	-	1	-	-
CO5	3	3	1	1	1	-	-	1	1	1	-	1	-	-
Avg.	**3**	**3**	**1**	**1**	**1**	-	-	**1**	**1**	**1**	-	**1**	-	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
USD24401	SOFT SKILL 2	2	0	0	0	100

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-Conjuction-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	BME	Programme Code & Name	121 BE- BME

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT24501	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	3	0	0	3	100
Course Objectives	**The objective of this course is to enable the student to** • Understand the devices for measurement of parameters related to cardiology. • Illustrate the recording and measurement of EEG • Demonstrate EMG recording unit and its uses. • Explain diagnostic and therapeutic devices related to respiratory parameters. • Understand the various sensory measurements that hold clinical importance.					

Unit-I	CARDIAC EQUIPMENT	(9)
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, Defibrillator -AC and DC Defibrillator- Internal and External.		
Unit-II	**NEUROLOGICAL EQUIPMENT**	**(9)**
Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.		
Unit-III	**MUSCULAR AND EXTRACORPOREAL DEVICES**	**(9)**
Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Heart Lung Machine, Types of oxygenators, Hemo Dialyser unit.		
Unit-IV	**RESPIRATORY MEASUREMENT AND ASSIST SYSTEM**	**(9)**
Spiro meter -Lung Volume and vital capacity, Pneumotachometer –Whole body Plethysmograph, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.		
Unit-V	**SENSORY DIAGNOSTIC EQUIPMENT**	**(9)**
Psycho physiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Application Tonometer, slit lamp, auto refractometer.		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
2	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012

REFERENCES:	
1	L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2	Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGraw-Hill Pub. Co.,Ltd. 2003
3	Antony Y.K.Chan,"Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the working and recording setup of all basic cardiac equipment
CO2:	Understand the working and recording of all basic neurological equipment's.
CO3:	Discuss the recording of diagnostic and therapeutic equipment's related to EMG
CO4:	Explain about measurements of parameters related to respiratory system.
CO5:	Describe the measurement techniques of sensory responses.

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMTL24501	EMBEDDED SYSTEMS AND IoMT	3	0	2	4	100
Course Objectives	**The objective of this course is to enable the student to** • Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware. • Understand the hardware architecture and features of embedded microcontrollers and peripherals. • Understand programming aspects of embedded system design. • Understand IoT architecture and Build simple IoT Systems using embedded target boards. • Understand IoMT infrastructure for healthcare applications.					

Unit-I	INTRODUCTION TO EMBEDDED SYSTEM DESIGN	(9)
Introduction to embedded processors- Application Areas- Categories of embedded processors- Challenges in Embedded System Design, Design Process- Requirements- Specifications- Hardware architecture- Software architecture-Introduction to Harvard & Von Neuman architectures- Memory Devices, and their Characteristics- RAM, EEPROM.		
Unit-II	**PERIPHERAL INTERFACING**	**(9)**
I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing- Memory interfacing with a case study- I/O Device Interfacing with case Study- Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth.		
Unit-III	**EMBEDDED SYSTEM SOFTWARE DESIGN**	**(9)**
Design techniques – State diagrams, sequence diagrams, flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages- embedded C / C++ Programming, Integrated Development Environment tools- Editor- Compiler- Linker- Automatic Code Generators- Debugger- Board Support Library- Chip Support Library.		
Unit-IV	**DESIGN AND DEVELOPMENT OF IOT**	**(9)**
Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT.		
Unit-V	**INTERNET OF MEDICAL THINGS**	**(9)**
Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, AdaBoost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy- Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments		

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Total No of Periods to be Taught	45

TEXT BOOK:	
1	Embedded Systems – A Contemporary Design Tool, James K Peckol, , John Weily, 2008, ISBN: 0-444-51616-6.
2	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “loT Fundamentals: Networking Technologies, Protocols and Use Cases for lnternet of Things, Cisco Press, 2017.
3	Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “lnternet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019

REFERENCES:	
1	Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790 3.
2	Embedded Software Primer, David E.Simon, Addison Wesley, ISBN-13: 978-0201615692
3	The Intel Microprocessors, Architecture, Programming and Interfacing” Barry B.Brey, 6th Edition, Pearson Education.
4	Arshdeep Bahga, Vijay Madisetti, “lnternet of Things – A hands-on approach”, Universities Press, 2015
5	Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
6	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Elsevier, 2014
7	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
8	Michael Margolis, Arduino Cookbook, “Recipes to Begin, Expand, and Enhance Your Projects”, OReilly Media, 2nd Edition

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List of Exercises/Experiments	
1. Explore AVR/ARM based controllers using Embedded C.	
2. Write Basic and arithmetic Programs Using Embedded C.	
3. Write Embedded C program to test interrupt and timers.	
4. Develop Real time applications – clock generation, waveform generation, counter using embedded C.	
5. Explore different communication methods with IoT devices.	
6. To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.	
7. To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.	
8. Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.	
9. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.	
10. Develop IoMT Application using open platform/ Aurdino. /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.	
11. Deploy IoMT applications using platforms.	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
CO2:	Describe the hardware architecture and features of embedded microcontrollers and peripherals
CO3:	Explain software design tools and embedded system design programming phases
CO4:	Describe IoT Architectures and Build simple IoT Systems using embedded target boards.
CO5:	Exhibit understanding of IoMT infrastructure for healthcare applications.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	ARM Controller boards	10 Nos
2	Arduino board	10 Nos
3	DHT 11 sensors	03 Nos
4	Temperature sensor	03 Nos
5	ECG sensor	03 Nos
6	Infrared sensor	03 Nos
7	RaspberryPi, Bluetooth/ WiFi modules	05 Nos
8	DC/Stepper motor	10 Nos
9	Pulse sensor	10 Nos
10	Pulse oximeter	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	1	1	1	-	-	-	-	-	1	1	1	-
CO2	3	2	1	1	1	-	-	-	-	-	1	1	1	-
CO3	3	2	1	1	1	-	-	-	-	-	1	1	1	-
CO4	3	2	1	1	1	-	-	-	-	-	1	1	1	-
CO5	3	2	1	1	1	-	-	-	-	-	1	1	1	-
Avg.	3	2	1	1	1	-	-	-	-	-	1	1	1	-
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	BME	**Programme Code & Name**	121- BME

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24501	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LAB**	0	0	4	2	100
Course Objectives	• To demonstrate recording and analysis of different Bio potentials • To examine different therapeutic modalities.					

List of Exercises/Experiments	
1. Measurement of visually and auditory evoked potential.	
2. Galvanic skin resistance (GSR) measurement.	
3. Measurement of output intensity from shortwave and ultrasonic diathermy.	
4. Measurement of various physiological signals using biotelemetry.	
5. Electrical safety measurements.	
6. Measurement of various physiological signals using biotelemetry.	
7. Measurement of stimulation current waveforms used in medical stimulator.	
8. Analyze the working of ESU–cutting and coagulation modes.	
9. Recording of Audiogram.	
10. Study the working of Defibrillator and pacemakers.	
11. Study of ECG, EEG and EMG electrodes.	
12. Study of ventilators	
13. Study of speech signals using speech signal trainer kit.	
14. Measurement of Oxygen Saturation and Heart Rate using Pulse-oximeter.	
15. Study of heart lung machine model.	
Total No of Periods to be Taught	**30**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Measure the different bioelectrical signals.
CO2:	Record the various physiological signals using telemetry.
CO3:	Demonstrate various diagnostic and therapeutic techniques
CO4:	Examine the electrical safety measurements
CO5:	Analyse the different bio signals using suitable tools.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	EEG Machine with Visually and Auditory evoked potential setup	1 Nos
2	GSR setup	1 Nos
3	Multi-output power supply (+15v, -15v, +30V variable, +5V, 2A)	2 Nos
4	Short wave Diathermy	1 Nos
5	Ultrasonic diathermy	1 Nos
6	Multiparameter biotelemetry system	1 Nos
7	Electrical Safety Analyser	1 Nos
8	ECG Simulator	1 Nos
9	Medical stimulator	1 Nos
10	Surgical diathermy with analyzer	1 Nos
11	Audiometer	1 Nos
12	Pacemaker and Defibrillator	1 Nos
13	Heart lung Model	1 Nos
14	Ventilator	1 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	3	1	1	1	-	-	1	1	-	1	2	-	1
CO2	3	3	1	1	1	-	-	1	1	-	1	2	-	1
CO3	3	3	1	1	1	-	-	1	1	1	1	2	-	1
CO4	3	3	1	1	1	-	-	1	1	1	1	2	-	1
CO5	3	3	1	1	1	-	-	1	1	1	1	2	-	1
Avg.	3	3	1	1	1	-	-	1	1	1	1	2	-	1
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B
Mecheri, Salem Dt-636453, Tamilnadu

Department	BME	**Programme Code & Name**	121- B.E BME

Semester V

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

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

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

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1	PCB Prototyping Machines	01 No
2	CNC Wood Router	01 No
3	CO_2 Laser Cutter	01 No
4	3D Printer	05 No
5	3D Scanner	02 No

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

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

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24502	**SUMMER INTERNSHIP**	0	0	0	1	100
Course Objectives	• Get connected with industry/laboratory/research institute • Get practical knowledge on production process in the industry/hospitals and develop skills to solve related problems. • Develop skills to carry out research in the research institutes/laboratories • The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.					

List of Exercises/Experiments	
The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.	
Total No of Periods to be Taught	**2 WEEKS**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	System level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the laboratory/research institute
CO2:	Analysis of industrial/ research problems and their solutions
CO3:	Documentation of system specifications, design methodologies, process parameters, testing parameters and results
CO4:	Preparing of technical report and presentation

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Department	BME	**Programme Code & Name**	121 B.E BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
USD24501	SOFT SKILL 3	2	0	0	0	100

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	BME	Programme Code & Name	121 BE- BME

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMT2401	MEDICAL IMAGING SYSTEMS	3	0	0	3	100
Course Objectives	To understand the generation of X-ray and its uses in Medical imaging To describe the principle of Computed Tomography. To know the techniques used for visualizing various sections of the body. To learn the principles of different radio diagnostic equipment in Imaging. To discuss the radiation therapy techniques and radiation safety					

Unit-I	X RAYS	(9)
Nature of X-rays- X-Ray absorption – X- Ray Equipment (Block Diagram) – X- Ray Tube, the collimator, Bucky Grid, Digital Radiography - discrete digital detectors, 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- properties of electromagnetic waves - Interaction of Nuclei with static magnetic field and Radio frequency wave-– bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system –generations of gradient magnetic fields, fMRI.		
Unit-IV	**NUCLEAR IMAGING**	**(9)**
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, and photomultiplier tube, pulse height analyzer. Principles of SPECT and PET.		
Unit-V	**RADIATION THERAPY AND RADIATION SAFETY**	**(9)**
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – 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**	

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TEXT BOOK:	
1	Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000
2	Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000

REFERENCES:	
1	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2	Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ",Springer-Verlag New York, 2011

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the working principle of the X-ray machine and its application.
CO2:	Illustrate the principle computed tomography
CO3:	Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
CO4:	Describe the working principle of the X-ray machine and its application.
CO5:	Demonstrate the applications of radionuclide imaging.

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSTL24401	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	2	4	100
Course Objectives	• Study about uninformed and Heuristic search techniques. • Learn techniques for reasoning under uncertainty. • Introduce Machine Learning and supervised learning algorithms. • Study about ensembling and unsupervised learning algorithms. • Learn the basics of deep learning using neural networks.					

Unit-I	PROBLEM SOLVING	(9)
Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).		
Unit-II	**PROBABILISTIC REASONING**	**(9)**
Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.		
Unit-III	**SUPERVISED LEARNING**	**(9)**
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.		
Unit-IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	**(9)**
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.		
Unit-V	**NEURAL NETWORKS**	**(9)**
Perception - Multilayer perceptron, activation functions, network training – gradient descent 94 Optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.		
Total No of Periods to be Taught	**45**	

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

REFERENCES:	
1	Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007.
2	Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008.
3	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (http://nptel.ac.in/).
5	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
6	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
7	Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014
8	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
9	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005

List of Exercises/Experiments	
1. Implementation of Uninformed search algorithms (BFS, DFS).	
2. Implementation of Informed search algorithms (A*, memory-bounded A*).	
3. Implement naïve Bayes models.	
4. Implement Bayesian Networks.	
5. Build Regression models.	
6. Build decision trees and random forests.	
7. Build SVM models.	
8. Implement ensembling techniques.	
9. Implement clustering algorithms.	
10. Implement EM for Bayesian networks.	
11. Build simple NN models.	
12. Build deep learning NN models	
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:	Use appropriate search algorithms for problem solving.
CO2:	Apply reasoning under uncertainty.
CO3:	Build supervised learning models.
CO4:	Build ensembling and unsupervised models
CO5:	Build deep learning neural network models

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	HP Proliant ML 110 Intel Xenon (R) CPU 32 GB RAM 2 TB HDD.	10
2	HP Elite Desk 800 G4 WKS TWR Intel Core (TM) I5-8500 3.00 GHZ Processor, 16 GB RAM 1TB HDD, 16 GB NVIDA Ge Force GTX 1660, IPS Display, HP - keyboard and mouse.	02
3	HP 280 G2 Intel Pentium i5 CPU 8GB RAM 1 TB HDD, HP keyboard, HP - keyboard, mouse and monitor.	02
4	HP Elite 8300 Intel Pentium i5 CPU core 2 duo 8GB RAM 500 GB HDD, HP - keyboard, mouse and monitor.	10
5	Dell Opti Plex E6550 Intel core 2 Duo CPU 2.33GHZ 4GB RAM 160GB HDD DVD ROM.	01
6	Vidia Jetson Nano kit	01

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

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

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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	-	-	-	-	-	1	1	-	1
CO2	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO3	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO4	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO5	3	3	1	1	1	-	-	-	-	-	1	1	-	1
Avg.	3	3	1	1	1	-	-	-	-	-	1	1	-	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121 BE- BME

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMTL24601	MEDICAL IMAGE PROCESSING	3	0	2	4	100
Course Objectives	• Learn the fundamental concepts of medical Image Processing techniques. • Understand the concepts of various image intensity transformation and filtering operations. • Be familiar in the techniques of segmentation and restoration of medical images. • Gain knowledge in medical image registration and visualization. • Be familiar with the application of medical image analysis.					

Unit-I	FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS	(9)
Overview of Image Processing system and human Visual system- Image representation – pixel and voxels, Gray scale and color models- Medical image file formats- DICOM, ANALYZE 7.5, NIFTI and INTERFILE- Discrete sampling model and Quantization- Relationship between the pixels, Arithmetic and logical operations- Image quality and Signal to Noise ratio- Image Transforms- 2D DFT, DCT, KLT.		
Unit-II	**ENHANCEMENT TECHNIQUES**	**(9)**
Gray level transformation- Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing- Histogram equalization, Histogram Matching. Spatial domain Filtering-Smoothing filters, sharpening filters. Frequency domain filtering- Smoothing filters, Sharpening filters- Homomorphic filtering -Medical image enhancement using Hybrid filters- Performance measures for enhancement techniques.		
Unit-III	**SEGMENTATION AND RESTORATION TECHNIQUES**	**(9)**
ROI definition -Detection of discontinuities–Edge linking and boundary detection – Region based segmentation- Morphological processing, Active contour models. Image Restoration- Noise models– Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering- Inverse filter, Weiner filtering.		
Unit-IV	**REGISTRATION AND VISUALISATION**	**(9)**
Registration–Rigid body transformation, principal axes registration, and feature based. Visualisation- Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab		
Unit-V	**APPLICATIONS OF MEDICAL IMAGE ANALYSIS**	**(9)**
Medical Image compression- DCT and Wavelet transform based image compression, Pre-processing of medical images -Retinal images, Ultrasound –liver, kidney, Mammogram. Segmentation of ROI -blood vessels, lesions, tumour, lung nodules, feature extraction- shape and texture, Computer aided diagnosis system – performance measures (confusion matrix, ROC, AUC).		
Total No of Periods to be Taught	**45**	

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TEXT BOOK:	
1	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, 98 3rd editions, 2016.
2	Isaac N. Bankman, Handbook of Medical Image Processing and Analysis, 2nd Edition, Elsevier, 2009
3	Wolfgang Birkfellner, Applied medical Image Processing: A Basic course, CRC Press, 2011

REFERENCES:	
1	Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA 2003
2	Rangaraj M. "Rangayyan, Biomedical Image Analysis", 1st Edition, CRC Press, Published December 30, 2004
3	Joseph V.Hajnal, Derek L.G.Hill, David J Hawkes, "Medical image registration", Biomedical Engineering series, CRC press,2001
4	Milan Sonka, Image Processing, Analysis And Machine Vision, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
5	Anil Jain K, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011.

List of Exercises/Experiments	
1. Interpret the basics of image models, Digitization of images and the transformations of medical images using Matlab	
2. Experiment with various filtering techniques for noise reduction and enhancement in medical images using Matlab.	
3. Analyze the segmentation techniques to extract the region of interest and restoration of degraded images using Matlab.	
4. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab	
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:	Explain and apply the fundamental concepts of image processing techniques for the analysis of medical images.
CO2:	Identify and apply suitable filtering and intensity transformation techniques for given medical applications
CO3:	Identify and segment the Region of Interest from the given medical image.
CO4:	Explore and apply current research in registration and visualization for medical image analysis.
CO5:	Design, apply the image compression techniques and evaluate the use of image processing fundamentals in healthcare applications, as well as their impact on health and society, and any underlying ethical issues, then communicate effectively through reflections, reports, and presentations (Target CO).

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	DESCRIPTION OF EQUIPMENT	REQUIRED NUMBERS
1	PCs with related accessories (Intel CORE 2 Duo(Minimum) or Intel I5, I7(latest), RAM2GB (Minimum), Hard Disk – 1TB)	30 Numbers
2.	Simulation softwares, Image processing tool box	15 user 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	3	1	1	1	-	-	-	-	-	1	1	-	1
CO2	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO3	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO4	3	3	1	1	1	-	-	-	-	-	1	1	-	1
CO5	3	3	1	1	1	-	-	-	-	-	1	1	-	1
Avg.	3	3	1	1	1	-	-	-	-	-	1	1	-	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy														

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Department	BME	**Programme Code & Name**	121 B.E BME

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24601	**MINIPROJECT**	0	0	4	2	100
Course Objectives	The objective of mini project is to enable students to work in groups of not more than three members in each group on a project involving analytical, experimental, design, simulation or combination of these in the area biomedical or allied engineering.					

List of Exercises/Experiments

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

Total No of Periods to be Taught	**60 PERIODS**

COURSE OUTCOMES:

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

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

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

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Department	Mechanical	**Programme Code & Name**	114-Mechanical

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
USD24601	SOFT SKILL 4	2	0	0	0	100

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/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.
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	BME	Programme Code & Name	121 BE- BME

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24701	HUMAN VALUES AND ETHICS	3	0	0	3	100
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	(9)
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement. Reading Text: Excerpts from John Stuart Mills' *On Liberty.*		
Unit-II	**SECULAR VALUES**	**(9)**
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani.		
Unit-III	**SCIENTIFIC VALUES**	**(9)**
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R.		
Unit-IV	**SOCIAL ETHICS**	**(9)**
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari.		
Unit-V	**SCIENTIFIC ETHICS**	**(9)**
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society. Reading Text*:* Excerpt from *American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.		
Total No of Periods to be Taught	**45**	

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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.

REFERENCES:	
1	The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
2	The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
3	Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

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

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24701	HOSPITAL TRAINING	0	0	0	2	100
Course Objectives	• Observe medical professionals at work in the wards and the roles of Allied Health Professionals; • Provide access to healthcare Professionals to get a better understanding of their work; • Demonstrate patient-care in a hospital setting.					
Assessment:						
	• Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session. • Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.					

List of Exercises/Experiments
1. Cardiology
2. ENT
3.Ophthalmology
4. Orthopaedic and Physiotherapy
5. ICU/CCU
6. Operation Theatre
Neurology
Nephrology
Radiology
Nuclear Medicine
Pulmonology
Urology
Obstetrics and Gynaecology
Emergency Medicine
Biomedical Engineering Department
Histo Pathology
Biochemistry

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Paediatric/Neonatal	
Dental	
Oncology	
PAC's	
Medical Records / Telemetry	
Total No of Periods to be Taught	**60**

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Advocate a patient-centred approach in healthcare
CO2:	Communicate with other health professionals in a respectful and responsible manner
CO3:	Recognize the importance of inter-professional collaboration in healthcare.
CO4:	Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
CO5:	Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

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Department	BME	Programme Code & Name	121- BE- BME

Semester VIII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBML24801	PROJECT WORK / INTERNSHIP	0	0	20	10	100
Course Objectives	• To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. 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 prepares 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

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

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

Semester

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

Unit-I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**(9)**
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.		
Unit-II	**PLANNING**	**(9)**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		
Unit-III	**ORGANISING**	**(9)**
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.		
Unit-IV	**DIRECTING**	**(9)**
Foundations of individual and group behaviour– Motivation – Motivation theories –Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		
Unit-V	**CONTROLLING**	**(9)**
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control –Productivity problems and management –Control and performance – Direct and preventive control – Reporting.		
Total No of Periods to be Taught		**45 periods**

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

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

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

Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	2	1	1
CO2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	1	-	-	2	1	-	1	-	2	-	1	1	-	-	2
CO4	-	1	1	1	1	-	-	1	2	-	-	-	1	1	1
CO5	1	-	-	-	1	1	-	-	-	3	-	1	1	-	1
Avg.	1.6	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24702	**TOTAL QUALITY MANAGEMENT**	3	0	0	3	100

Course Objectives	• Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. • Explain the TQM Principles for application. Describe Taguchi's Quality Loss Function, performance measures and apply Techniques like QFD, TPM, COQ and BPR. • Illustrate and apply QMS and EMS in any organization. • Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

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

T. Sivakumar

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Total No of Periods to be Taught	45 periods

TEXT BOOK:	
1	Dale H. Besterfiled, Carol B.Michna, Glen H.Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe,"Total Quality Management",Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

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

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

Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO 11	PO1 2	PSO 1	PSO 2	PSO3
CO1	-	3	-	-	-	-	-	-	-	-	-	3	2	-	3
CO2	-	-	-	-	-	3	-	-	-	-	-	3	-	2	
CO3	-	-	-	-	3	-	-	-	3	-	-		-	2	3
CO4	-	2	-	-	3	2	3	2	-	-	-	3	3	2	
CO5			3			3	3	2							
Avg.	-	3	-	-	-	-	-	-	-	-	-	3	2	-	3

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

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THE KAVERY ENGINEERING COLLEGE

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24703	**ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING**	3	0	0	3	100

Course Objectives	• Understanding the concept of Engineering Economics. • Implement various micro economics concept in real life. • Gaining knowledge in the field of macro economics to enable the students to have better understanding of various components of macroeconomics. • Understanding the different procedures of pricing. • Learn the various cost related concepts in microeconomics.

Unit-I	**DEMAND&SUPPLY ANALYSIS**	**(9)**
Managerial Economics-Relationship with other disciplines-Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand – Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply – Determinants of supply - Supply function -Supply elasticity.		
Unit-II	**PRODUCTIONANDCOST ANALYSIS**	**(9)**
Production function-Returns to scale - Production optimization-Least cost input- Isoquants – Managerial uses of production function. Cost Concepts-Cost function-Determinants of cost-Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.		
Unit-III	**PRICING**	**(9)**
DeterminantsofPrice-Pricingunderdifferentobjectivesanddifferentmarketstructures – Price discrimination-Pricing methods in practice.		
Unit-IV	**FINANCIALACCOUNTING(ELEMENTARYTREATMENT)**	**(9)**
Balance sheet and related concepts- Profit & Loss Statement and related concepts—Financial Ratio Analysis-Cash flow analysis-Funds flow analysis- Comparative financial statements-Analysis & Interpretation official statements.		
Unit-V	**CAPITALBUDGETING(ELEMENTARYTREATMENT)**	**(9)**
Investments- Risks and return evaluation of investment decision- Average rate of return- Payback Period-Net Present Value- Internal rate of return.		
Total No of Periods to be Taught		**45 periods**

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

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

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

Mapping of COs with POs and PSOs

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

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24704	**HUMAN RESOURCE MANAGEMENT**	3	0	0	3	100
Course Objectives	• To provide knowledge about management issues related to staffing, • To provide knowledge about management issues related to training, • To provide knowledge about management issues related to performance • To provide knowledge about management issues related to compensation • To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.					

Unit-I	**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT**	**(9)**
The importance of human resources– Objective of Human Resource Management-Human resource policies - Role of human resource manager.		
Unit-II	**HUMAN RESOURCE PLANNING**	**(9)**
Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.		
Unit-III	**TRAININGAND EXECUTIVE DEVELOPMENT**	**(9)**
Types of training and Executive development methods–purpose–benefits.		
Unit-IV	**EMPLOYEE COMPENSATION**	**(9)**
Compensationplan–Reward–Motivation–CareerDevelopment-Mentor–Protege relationships.		
Unit-V	**PERFORMANCE EVALUATION AND CONTROL**	**(9)**
Performance evaluation – Feedback - The control process – Importance –Methods – grievances – Causes – Redressal methods.		
Total No of Periods to be Taught		**45 periods**

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

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

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

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24705	KNOWLEDGE MANAGEMENT					100

Course Objectives	The student should be made to: • Learn the Evolution of Knowledge management. • Be familiar with tools. • Be exposed to Applications. • Be familiar with some case studies.

Unit-I	INTRODUCTION	(9)
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.		
Unit-II	**CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING**	**(9)**
Organization and Knowledge Management –Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists–Tacit Knowledge and Quality Assurance.		
Unit-III	**KNOWLEDGE MANAGEMENT – THE TOOLS**	**(9)**
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.		
Unit-IV	**KNOWLEDGE MANAGEMENT APPLICATION**	**(9)**
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI		
Unit-V	**RESPIRATORY DISEASES**	**(9)**
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life cycles of an organization.		
Total No of Periods to be Taught		**45 periods**

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TEXT BOOK:	
1	Srikantaiah,T.K.,Koenig,M.,"KnowledgeManagementfortheInformationProfessional" Information Today, Inc., 2000.

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

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the process of acquiry knowledge from experts
CO2:	Understand the learning organization.
CO3:	Use the knowledge management tools.
CO4:	Develop knowledge management Applications.
CO5:	Design and develop enterprise applications.

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UGET24706	**INDUSTRIAL MANAGEMENT**	3	0	0	3	100
Course Objectives	• To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations. • To study the planning; organizing and staffing functions of management in professional organization. • To study the leading; controlling and decision-making functions of management in professional organization. • To learn the organizational theory in professional organization. • To learn the principles of productivity and modern concepts in management in professional organization.					

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; Weber; Parker – Forms of Organization: Sole Proprietorship;Partnership;Company(PrivateandPublic);Cooperative– Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.		
Unit-II	**FUNCTIONS OF MANAGEMENT - II**	**(9)**
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake – Mount on, Reddin)– Communication: Purpose; Model; Barriers– Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.		
Unit-III	**FUNCTIONS OF MANAGEMENT - II**	**(9)**
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids(Blake – Mount on, Reddin)– Communication: Purpose; Model; Barriers– Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.		
Unit-IV	**ORGANIZATION THEORY**	**(9)**
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management–Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory –Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.		
Unit-V	**PRODUCTIVITY AND MODERN TOPICS**	**(9)**
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Bench		

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marking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems(MIS).	
Total No of Periods to be Taught	**45 periods**

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

REFERENCES:	
1	JosephJ, Massie,"Essentials of Management",4thEdition, PearsonEducation,1987.
2	Saxena, P.K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3	S. Chandran," Organizational Behaviours ",Vikas Publishing HousePvt.Ltd.,1994.
4	RichardL. 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:	Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
CO2:	Discuss the planning; organizing and staffing functions of management in professional organization.
CO3:	Apply the leading; controlling and decision-making functions of management in professional organization.
CO4:	Discuss the organizational theory in professional organization.
CO5:	Apply principles of productivity and modern concepts in management in professional organization.

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Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO2	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO3	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO4	1	1	1	1	1	3	2	3	2	3	1	3	1	1
CO5	1	1	1	1	1	3	2	3	2	3	1	3	1	1
Avg.	1	1	1	1	1	3	2	3	2	3	1	3	1	1
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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

Total No of Periods to be Taught	**Total : 30 Periods**

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

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

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

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

COURSE CONTENTS

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

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

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

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

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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

REFERENCES:	
1	Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.
2	John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All IndiaTraveller Book Seller, Delhi.
3	Ronald P. Blake. (1973). Industrial safety. Prentice Hall, NewDelhi

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

Mapping of COs with POs and PSOs

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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

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

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

Mapping of COs with POs and PSOs

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

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

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

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

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Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions	
Total No of Periods to be Taught	**Total: 30 periods**

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

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

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

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Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	-	-	-	-	-	2	2
CO2	3	3	3	3	2	2	3	-	-	-	-	-	3	3
CO3	2	2	3	3	2	2	3	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	3	-	-	-	-	-	3	3
CO5	2	2	3	2	3	3	3	-	-	-	-	-	3	3
Avg.	**2.6**	**2.6**	**2.8**	**2.6**	**2.4**	**2.4**	**2.8**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	MECHANICAL	Programme Code & Name	Mandatory Courses- All Branches

Semester

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

Unit-I	HEALTH AND ITS IMPORTANCE	(6)

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath. **Present health status -** The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.**Types of diseases and disorders -** Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time **Simple lifestyle modifications to maintain health -** Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

Unit-II	DIET	(6)

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.**Food additives and their merits & demerits -** Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions**Definition of BMI and maintaining it with diet**Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes Different cooking methods, merits and demerits of each method

Unit-III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	(6)

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AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.
Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri- Dosha Theory) - Udal Thathukkal
Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

Unit-IV	MENTAL WELLNESS	(6)

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

Unit-V	YOGA	(6)

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

Total No of Periods to be Taught	Total: 30 periods

TEXT BOOK:

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

REFERENCES:

1	WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England

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

COURSE OUTCOMES:

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

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

Mapping of COs with POs and PSOs

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

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STREAM- I

BIOENGINEERING

Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2401	BIO-MATERIALS	3	0	0	3	100
Course Objectives	The student should be made to: • Learn characteristics and classification of Biomaterials • Understand different metals, ceramics and its nonmaterial's characteristics as biomaterials • Learn polymeric materials and its combinations that could be used as a tissue replacement implants • Get familiarized with the concepts of Nano Science and Technology Understand the concept of biocompatibility and the methods for biomaterials testing					

Unit-I	INTRODUCTION TO BIO-MATERIALS	(9)
Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.		
Unit-II	**METALLIC AND CERAMIC MATERIALS**	**(9)**
Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant — bio inert, biodegradable or bioresorbable, bioactive ceramics, nano structured bio ceramics.		
Unit-III	**POLYMERIC IMPLANT MATERIALS**	**(9)**
Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.		
Unit-IV	**TISSUE REPLACEMENT IMPLANTS**	**(9)**
Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.		
Unit-V	**TESTING OF BIOMATERIALS**	**(9)**
Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, Invitro and Invivo testing; Sterilization of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Sujata V. Bhatt Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2	JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press,2003

REFERENCES:	
1	Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O.Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.
2	Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. "Implantbiomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.
3	Biomaterials- Basic Theory with Engineering Applications C.Mauli Agarwal, Joo L.Ong,Mark R. Appleford, Gopinath Mani. Cambrige University Press, New York- 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Analyze different types of Biomaterials and its classification and apply the concept of nano technology towards biomaterials use.
CO2:	Identify significant gap required to overcome challenges and further development inmetallic and ceramic materials
CO3:	Identify significant gap required to overcome challenges and further development inpolymeric materials
CO4:	Create combinations of materials that could be used as a tissue replacement implant.
CO5:	Understand the testing standards applied for biomaterials.

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2402	ARTIFICIAL ORGANS AND IMPLANTS	3	0	0	3	100
Course Objectives	**The student should be made to:** • To have an overview of artificial organs & transplants • To describe the principles of implant design with a case study • To explain the implant design parameters and solution in use • To study about various blood interfacing implants • To study about soft tissue replacement and hard tissue replacement					

Unit-I	ARTIFICIAL ORGANS & TRANSPLANTS	(9)
ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process. **TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.**		
Unit-II	**PRINCIPLES OF IMPLANT DESIGN**	**(9)**
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.		
Unit-III	**IMPLANT DESIGN PARAMETERS AND ITS SOLUTION**	**(9)**
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.		
Unit-IV	**BLOOD INTERFACING IMPLANTS**	**(9)**
Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.		
Unit-V	**IMPLANTABLE MEDICAL DEVICES AND ORGANS**	**(9)**
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976

REFERENCES:	
1	J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
2	R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003
3	Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001. ISBN: 9780387952147.
4	John Enderle, Joseph D.Bronzino, Susan M.Blanchard, ""Introduction to Biomedical Engineering", Elsevier, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Gain adequate knowledge about artificial organs & transplants
CO2:	Get clear idea about implant design and its parameters and solution
CO3:	Have in-depth knowledge about blood interfacing implants
CO4:	Explain different types of soft tissue replacement and hard tissue replacement
CO5:	Assess compatibility and functioning of artificial organs inside the living 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	3	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	1	-	-
CO5	3	3	1	1	1	-	-	-	-	-	-	1	-	-
Avg.	3	3	1	1	1	-	-	-	-	-	-	1	-	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2403	BIOMEDICAL OPTICS AND BIOPHOTONICS	3	0	0	3	100
Course Objectives	• To acquire knowledge about the physical properties of light and optical properties of tissues. • Learn the design and working principle of various optical components. • Understand the principles and applications of optical biosensors. • Understand the engineering and practical applications of optics related to diagnostic and surgical applications. • Understand the phenomenon of laser tissue interaction and practical applications of optics related to therapeutic applications.					

Unit-I	OPTICAL PROPERTIES	(6)
Basic principles of light - Reflection - Refraction - Absorption - Polarization - Interference - Coherence, Basic laws of light - Beer Lambert law - Snell's law, Optical properties of tissues - Absorption - Scattering - Anisotropy.		
Unit-II	**OPTICAL INSTRUMENTATION**	**(6)**
Working principle of light sources - Lasers - LEDs, Working principle of optical detectors - Photodiode - Spectrometer - CMOS and CCD cameras - Lens - Optical filters - Optical fibers.		
Unit-III	**OPTICAL BIOSENSORS**	**(6)**
Principles of Optical biosensing - Immobilization of bio-recognition elements, Types of optical biosensor - Fiber optic - Planar waveguide - Evanescent - Interferometric - Surface plasmon resonance – Advantages and disadvantages - Applications.		
Unit-IV	**APPLICATIONS OF LASERS**	**(6)**
Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photoacoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyperspectral imaging. Surgical - Lasers in dentistry, Dermatology, Ophthalmology.		
Unit-V	**LASER TISSUE INTERACTION**	**(6)**

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Laser tissue interactions via photochemical, Photo thermal, Photomechanical techniques, Photodynamic therapy (PDT) - Oncological and non-oncological applications, Low level laser therapy (LLLT) – Bio stimulation applications.

TEXT BOOK:	
1	Tuan Vo Dinh, "Biomedical Photonics –Handbook, CRC Press, Bocaraton, 2014.
2	Jurgen Popp, Valery V. Tuchin, Arthur Chiou and Stefen Heinemann, Handbook of Biophotonics, Vol 2: Photonics for Healthcare, John Wiley and Sons, 1st Edition, 2011.

REFERENCES:	
1	Markolf H. Niemz, "Laser-Tissue Interaction Fundamentals and Applications" Springer,2007.
2	Splinter R and Hooper B. A., "An Introduction to Biomedical Optics", Taylor and Francis,2006
3	Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications",Academic Press, 2006
4	Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and sons, Inc. Publications,2003.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the various physical properties of light and optical properties of tissues.
CO2:	Consolidate the working principles of optical components.
CO3:	Discuss the various applications of biosensors in medicine.
CO4:	Summarize the diagnostic and surgical applications of lasers in medicine.
CO5:	Explain the laser tissue interaction and various therapeutic applications of lasers.

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	-	-	-	-	-	-	-	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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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2404	NEURAL ENGINEERING	3	0	0	3	100
Course Objectives	• To be familiar with the nervous system development • To be exposed to neuronal diseases and disorders • To be familiar with nerve reconstruction and repairing					

Unit-I	**BASICS OF NEURON STRUCTURE AND FUNCTIONS**	**(9)**
Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure — function — classification. Glial cells — myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons.		
Unit-II	**BRAIN, BRAIN STEM AND SPINAL CORD**	**(9)**
Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Bloodsupply to Brain and spinal cord.		
Unit-III	**NEURONAL DISEASES AND DISORDERS**	**(9)**
Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration. Neuronal plasticity — CNS acting drugs and their pharmacokinetics. Alzheimer‘s, Parkinson‘s and Prion diseases		
Unit-IV	**NEUROPHYSIOLOGY & NEURORADIOLOGY**	**(9)**
Physiology of nerve conduction. Peripheral nerves — structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system. Neuromotor-machine interface: human voluntary motor control system.		
Unit-V	**NERVE RECONSTRUCTION AND REHABILITATION**	**(9)**
Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	Mathews G.G., “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000
2	Malcom Carpenter, “Textbooks of Neuroanatomy”, Mc. Graw hill Edition, 1996

REFERENCES:
W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue’’, Oxford University Press Inc New York, 2004.
Park J.B., “ACS Biomaterials Science and Engineering”, Plenum Press, 2014. Saunders, 2006.

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COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the basic structure and functions of human nervous system.
CO2:	Understand diseases and degeneration related to nervous system.
CO3:	Analyze visualization and radiological assessment of nervous system
CO4:	Apply neural tissue engineering for rehabilitation.
CO5:	Discuss about Regeneration of nervous system.

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	-	-	-	-	-	-	-	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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Course Code	Course Name	Hours/Week	Credit	Maximum Marks

UBMPE2405	PRINCIPLES OF TISSUE ENGINEERING	L	T	P	C	100
		3	0	0	3	
	• 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 TO CELL BIOLOGY	(9)
Cell types - Progenitor cells - Cell growth and differentiation - Cell culture: Expansion - Transfer - Storage and Characterization - Cell signalling molecules - Growth factors - Cell attachment: Differential cell adhesion, Receptor-ligand binding - Cell surface markers.		
Unit-II	**FUNDAMENTALS OF TISSUE ENGINEERING**	**(9)**
History and scope of tissue engineering - Tissue organization - Tissue types: Epithelial, Connective- Vascularity and angiogenesis - Wound healing - Extra Cellular Matrix: Matrix molecules and their ligands - Tissue culture – Materials in tissue engineering.		
Unit-III	**STEM CELLS**	**(9)**
Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pleuripotent stem cells.		
Unit-IV	**ENGINEERING METHODS AND DESIGN**	**(9)**
Soft lithography - Self-assembled monolayer, Micro contact printing, Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels - Polymer scaffolds fabrications: Electro spinning - Solvent casting and particulate leaching - Micro fabrication of cell seeded scaffolds.		
Unit-V	**APPLICATION OF TISSUE ENGINEERING**	**(9)**
Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver - Regenerative engineering: Peripheral Nerve regeneration, Cardiac tissue regeneration, Muscle regeneration – Regulation, Commercialization and Patenting.		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	Robert P lanza, Robert Langer, Joseph Vacanti, "Principles of Tissue Engineering", Academic Press, United States, 2020.

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2	Donglu Shi, Qing Liu, "Tissue Engineering and Nanotheranostics", World Scientific Publications, Singapore, 2018.
REFERENCES:	
1	Gary E. Wnek, Gary L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc, New York, 2008.
2	R. Lanza, Anthony Atala (Eds), "Essential of Stem Cell Biology", Academic Press, USA, 2013.
3	R. Lanza, Anthony Atala,"Handbook of Stem Cells'', Academic Press, USA, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the basic concepts of tissue engineering
CO2:	Acquire ability to function on multi-disciplinary teams
CO3:	Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies
CO4:	Design and develop different biomaterial in tissue engineering application
CO5:	Gain knowledge in research or clinical application on tissue repair/ engineering

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

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2406	**GENETIC ENGINEERING**	**3**	**0**	**0**	**3**	100
Course Objectives	• To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics. • To explain the heterologous expression of cloned genes in different hosts.					

Unit-I	**BASICS OF RECOMBINANT DNA TECHNOLOGY**	**(9)**
Manipulation of DNA – Restriction and Modification enzymes - Design of linkers and adaptors - Characteristics of cloning and expression vectors - Introduction of recombinant DNA in to host cells and selection methods.		
Unit-II	**DNA LIBRARIES**	**(9)**
Construction of genomic and cDNA libraries, Artificial chromosomes – Bacteria, Yeast - Chromosomal walking.		
Unit-III	**SEQUENCING AND AMPLIFICATION OF DNA**	**(9)**
Maxam Gilbert's and Sanger's methods of DNA sequencing – PCR: Inverse PCR, Nested PCR, Allele specific PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.		
Unit-IV	**ORGANIZATION AND STRUCTURE OF GENOMES**	**(9)**
Organization and structure of genomes - Genome sequencing methods: Conventional and shotgun genome sequencing methods, Next generation sequencing technologies - Ordering the genome sequence - Genetic maps and Physical maps, STS content based mapping, Hybridization mapping, Optical mapping.		
Unit-V	**CURRENT STATUS OF GENOME SEQUENCING PROJECTS**	**(9)**
Introduction to Functional genomics – Microarrays - Serial Analysis of Gene expression (SAGE), Subtractive hybridization, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.		
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:
Isil Aksan Kurnaz, "Techniques in Genetic Engineering", CRC Press, 2015.
Oksana Ableitner, "Introduction to Molecular Biology: Working with DNA and RNA (essentials)", Springer International, 2022.
Arun K. Shukla, "Proteomics in Biology", Academic Press, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Would be aware of how to clone commercially important genes.
CO2:	The students would be aware of how to produce the commercially important recombinant proteins.
CO3:	Will be familiarized with gene and genome sequencing techniques
CO4:	Will be aware of microarrays, Analysis of Gene expression and proteomics.
CO5:	Acquire ability to function on multi-disciplinary teams

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

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STREAM- II

MANAGEMENT (HEALTHCARE)

Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2407	CLINICAL ENGINEERING	3	0	0	3	100
Course Objectives	• This course will provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations. • This course will enhance students to practice medical equipment and analyze challenges with their healthcare technology. • This course will engage the students to work as a team to address problems and errors in medical devices. • This course will help students to design better medical devices with computerized approaches. • This course will expose students to explore the Health Technology Management systems with medical devices and supportive services with advanced application.					

Unit-I	INTRODUCTION	(9)
Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.		
Unit-II	**MEDICAL TECHNOLOGY MANAGEMENT PRACTICES**	**(9)**
Strategic Medical Technology Planning, Scope, Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.		
Unit-III	**ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP)**	**(9)**
Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.		
Unit-IV	**CLINICAL ENGINEERING PROGRAM INDICATOR**	**(9)**
Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.		
Unit-V	**ADVANCED TECHNOLOGY FOR PATIENT SAFETY**	**(9)**

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Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.	
Total No of Periods to be Taught	**45 periods**

TEXT BOOK:	
1	Ernesto Iadanza, Joseph Dyro, "Clinical Engineering Handbook", Elsevier Academic Press, 2014
2	Robert Miniati, "Clinical Engineering from Devices to Systems", Academic Press, 23-Dec- 2015 - Technology & Engineering

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology
CO2:	Give the program and framework to recognize the errors of medical equipment
CO3:	State the issues or errors in patient safety and formulate patient safety package system
CO4:	Define the problem precisely and examine the possible issues using program indicators.
CO5:	Demonstrate computer-based equipment with automated system by using CPOE method

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	-	-	-	-	-	-
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	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2408	HOSPITAL PLANNING AND MANAGEMENT	3	0	0	3	100
Course Objectives	• To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues • The student should be made to understand the principles, practices and areas of application in Hospital management.					

Unit-I	OVERVIEW OF HOSPITAL ADMINISTRATION	(9)
Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management		
Unit-II	**HUMAN RESOURCE MANAGEMENT IN HOSPITAL**	**(9)**
Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		
Unit-III	**MARKETING RESEARCH & CONSUMER BEHAVIOUR**	**(9)**
Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.		
Unit-IV	**HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES**	**(9)**
Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.		
Unit-V	**QUALITY AND SAFETY ASPECTS IN HOSPITAL**	**(9)**

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Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.	
Total No of Periods to be Taught	**Total: 45 periods**

TEXT BOOK:	
1	R.C. Goyal, "Hospital Administration and Human Resource Management", PHI–4th Edition,2006.
2	G.D.Kunders, "Hospitals – Facilities Planning and Management", TMH, New Delhi – 5th edition Reprint 2007

REFERENCES:	
1	Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995.
2	Norman Metzger, "Handbook of Health Care Human
3	Arnold D. Kalcizony & Stephen M.Shortell, "Health Care Management", 6th Edition, 2011.
4	Blane, David, Brunner, Eric, "Health and Social organization: Towards a health policy for the 21st century", Calrendon Press, 1994

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the principles, practices and areas of application in Hospital Management.
CO2:	Understand the biomedical waste disposal concept.
CO3:	Explain the importance of supportive services.
CO4:	Comprehend the quality aspect specified by the international standards.
CO5:	Knowledge on Hospital safety.

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2409	MEDICAL WASTE MANAGEMENT	3	0	0	3	100
Course Objectives	The student should be made to: • Understand the hazardous materials used in hospital and its impact on health • Understand various waste disposal procedures and management.					

Unit-I	HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS	(9)
Healthcare Hazard Control: Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.		
Unit-II	**BIOMEDICAL WASTE MANAGEMENT**	**(9)**
Biomedical Waste Management: Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.		
Unit-III	**HAZARDOUS MATERIALS**	**(9)**
Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.		
Unit-IV	**FACILITY SAFETY**	**(9)**
Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.		
Unit-V	**INFECTION CONTROL, PREVENTION AND PATIENT SAFETY**	**(9)**

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Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Blood borne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

Total No of Periods to be Taught	**45 periods**

TEXT BOOK:	
1	Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)
2	Tweedy, James T., Healthcare hazard control and safety management-CRC Press Taylor and Francis (2014).

REFERENCES:	
1	R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006
2	V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Analyse various hazards, accidents and its control
CO2:	Design waste disposal procedures for different biowastes
CO3:	Categorise different biowastes based on its properties
CO4:	Design different safety facility in hospitals
CO5:	Propose various regulations and safety norms

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2410	ECONOMICS AND MANAGEMENT FOR ENGINEERS	3	0	0	3	100
Course Objectives	• To understand the concepts of Economics with respect to the demand and supply analysis. • To analyze the theory of production and the analysis of the cost parameter by using the Elasticity. • To manage and plan the situation with the help of the available strategies to support the decision making process.					

Unit-I	INTRODUCTION TO ECONOMICS	(9)
Introduction to Economics – Scope of Economics – Positive and Normative Science – Methodology of Economics – Economic Laws - Economy and its basic problems: Economy and its working – Kinds of economy systems – Basic problems of economy.		
Unit-II	**DEMAND AND SUPPLY ANALYSIS**	**(9)**
The Law of Demand – The Law of Supply – Elasticities of Demand and Supply: Price Elasticity of Demand - Price Elasticity and Consumption Expenditure- Cross Elasticity of Demand – Income Elasticity of Demand – The Elasticity of Price Expectations – The uses of Elasticity– Price Elasticity of Supply.		
Unit-III	**THEORY OF PRODUCTION AND ANALYSIS OF COST**	**(9)**
Meaning of Production – Production concepts – Production Function – Laws of Production – Cost Concepts - Short-Run Cost Output Relations – Long Run Cost output relations – Economics of Scale.		
Unit-IV	**INTRODUCTION TO MANAGEMENT**	**(9)**
Management: Overview – Management Defined – Managerial skills – Managerial roles – Management responsibilities – Management functions. Evolution of Management: Classical approaches to Management – Contemporary Management Perspectives.		
Unit-V	**PLANNING**	**(9)**
Planning and Forecasting: Importance of Planning – Principles of effective Planning – Planning process – Types of Plans. Strategic Planning: Strategic Planning process – Rational decision making.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	D.N.Dwivedi, "Principles of Economics", Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012.
2	J.S.Chandan, "Management Concepts and Strategies", Vikas Publishing House (P) Limited, New Delhi, 2003.

REFERENCES:	
1	D.N.Dwivedi, "Principles of Economics", Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012.
2	J.S.Chandan, "Management Concepts and Strategies", Vikas Publishing House (P) Limited, New Delhi, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Summarize how to solve economics principles to solve economic problems in engineering discipline by satisfying the economic laws.
CO2:	Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity.
CO3:	Interpret short run and long run costs in the process of production for carrying out a business.
CO4:	Apply managerial skills to make decisions and solve problems for achieving organizational objectives.
CO5:	Express the principles of effective planning for survival and success of all organizations using standing and single use planning methods.

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

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

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2411	**BIOSTATISTICS**	**3**	**0**	**0**	**3**	100
Course Objectives	• Understand the statistical methods for the data. • Comprehend the fundamental of mathematical and statistical theory in the application of biomedical field. • Apply the regression and correlation analyze in the physiological data. • Understand the source of Medical data • Understand the Visual analytics of Healthcare data.					

Unit-I	**INTRODUCTION**	**(6)**
Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and medical data analysis, Introduction to probability, likelihood & odds, distribution variability.		
Unit-II	**STATISTICAL PARAMETERS**	**(6)**
Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.		
Unit-III	**INTERPRETING DATA**	**(6)**
Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.		
Unit-IV	**INTERPRETING DATA**	**(6)**
Interpreting life tables clinical trials, epidemical reading and interpreting of epidemical studies, application in community health.		
Unit-V	**ANALYSIS OF VARIANCE**	**(6)**
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.		

TEXT BOOK:

Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley & Sons Publication, 10th Edition, 2013.

Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001.

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REFERENCES:	
1	Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2nd Edition, 2018.
2	Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014.
3	Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Define the new and existing statistical methodology for their research problem.
CO2:	Explain p- values for different statistical tests.
CO3:	Analyze the biomedical research data and be able to report the study results.
CO4:	Describe the various sources of medical data
CO5:	Demonstrate the visual analytical procedure of Medical Data.

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	-	-	-
CO2	3	2	-	-	-	1	-	1	1	-	1	-	-	-
CO3	3	2	-	-	-	1	-	1	1	-	1	-	-	-
CO4	3	2	-	-	-	1	-	1	1	-	1	-	-	-
CO5	3	2	-	-	-	1	-	1	1	-	1	-	-	-
Avg.	3	2	-	-	-	1	-	1	1	-	1	-	-	-
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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2412	FORENSIC SCIENCE IN HEALTHCARE	3	0	0	3	100
Course Objectives	**By the end of the course each student will be familiar with:** • The history of the forensic sciences and its place in popular culture • The roles of different types of professionals involved in evaluating a crime scene and the collected evidence • Forensic microscope and Anthropology • The Blood stain identification • the methodology of collecting & interpreting data for fingerprint application					

Unit-I	BASICS OF FORENSIC SCIENCE	(9)
Forensic science, Introduction to the Forensic Sciences, History and Development of Forensic Science, Deductive Reasoning, Organization of a Crime Laboratory Case Studies: The Enrique Camarena Case. A Forensic Nightmare Organization of forensic science laboratories of center and state -NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions.		
Unit-II	**OBSERVATION AND CRIME SCENE**	**(9)**
Observational Skills - Sherlock Holmes and Deductive Reasoning - Observations by Witnesses. Case Studies. The Crime Scene -Locard's Exchange Principle, Securing and Recording the Crime Scene, Legal Considerations at the Crime Scene, Evidence Collection and Recordation Techniques. Mock Crime Scene: Processing and Documenting a Crime Scene		
Unit-III	**FORENSIC MICROSCOPE AND ANTHROPOLOGY**	**(9)**
Forensic Use of the Microscope -The Compound, Comparison, and Stereoscopic Microscope, The Scanning Electron Microscope (SEM). Forensic Anthropology- Introduction, Human Anatomy–The Skeletal System, Skeletal Determination of Demographic Data from Skeletal Remains, Determining Types of Trauma and Disease from Skeletal Remains, Case Studies.		
Unit-IV	**BLOOD STAIN IDENTIFICATION**	**(9)**
Detection and identification of Blood stains, Determination of species of origin, Blood Group systems, Techniques of Determination of Blood groups of Blood stains, Determination of seminal and other fluids and their Blood Grouping, DNA, DNA Phenotyping and RNA Profiling & their applications. Wildlife forensics.		
Unit-V	**FINGERPRINT APPLICATION**	**(9)**
Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi.
2	James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press,

REFERENCES:	
1	Saferstein : Criminalistics (1976) Prentice Hall Inc., USA.
2	Deforest, Gansellen & Lee : Introduction to Criminalistics.
3	Sharma, B.R. (1974) Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 1974

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Define the significance of forensic sciences
CO2:	Observe and document crime scenes
CO3:	Determine Trauma and Diseases.
CO4:	Describe the various sources of medical data related to forensic science.
CO5:	Demonstrate the visual analytical procedure of finger print application

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

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

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STREAM- III

ADVANCED HEALTHCARE DEVICES

Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2413	BIO MEMS	3	0	0	3	100

Course Objectives	**The objective of this course is to enable the student to** ● Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices. ● Understand various mechanical and thermal sensors and actuators and their principles of operation at the micro scale level. ● Understand various electrostatic and piezoelectric sensors and actuators at the micro scale level. ● Introduce microfluidic systems. ● Know on the applications of MEMS in different field of medicine.

Unit-I	MEMS MATERIALS AND FABRICATION	(9)
Semiconductor materials; photo lithography; doping; thin film growth and deposition; CVD and Ion Implantation, metallization; wet and dry etching; silicon micromachining; metal MEMS processes; submicron optical lithography; electron beam lithography; soft lithography and printing.		
Unit-II	**MECHANICAL AND THERMAL SENSORS AND ACTUATORS**	**(9)**
Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor.		
Unit-III	**ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATOR**	**(9)**
Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.		
Unit-IV	**MICROFLUIDIC SYSTEMS**	**(9)**
Laminar flow in circular conduits, fluid flow in micro conduits, in sub micrometer and nanoscale. microfluidic components (filters, mixers, valves, and pumps)		
Unit-V	**APPLICATIONS OF BIOMEMS**	**(9)**
CAD for MEMS, DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor. Introduction to the MATLAB/Simulink/ CAD tool for modelling/simulations of bioelectronics systems.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	TaiRan Hsu, MEMS and Microsystems Design and Manufacture, Tata McGrawHill Publishing Company, New Delhi, 2017.
2	Wanjun Wang and Stephen A. Soper, Bio MEMS: Technologies and Applications, CRC Press, NewYork, 2007.

REFERENCES:	
1	Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey, USA, 2011.
2	Ellis Meng, Biomedical Microsystems, CRC Press, Boca Raton, FL, 2011.
3	P. Tabeling, S .Chen, Introduction to microfluidics, Oxford University Press, 2010.
4	Alok Pandya ,Vijai Singh, Micro/Nanofluidics and Lab-on-Chip Based Emerging Technologies for Biomedical and Translational Research Applications - Part B, Academic Press, 2022

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Summarize various MEMS fabrication techniques.
CO2:	Elucidate different types of mechanical and thermal sensors and actuators and their principles of operation at the micro Scale level.
CO3:	Describe different types of various electrostatic and piezoelectric sensors and actuators and their principles of operation at the micro Scale level.
CO4:	Explain microfluidic systems
CO5:	Illustrate MEMS in different field of medicine.

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	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	2	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	2	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	2	-	-	-	-	-	-	1	-	-
Avg.	3	2	1	1	2	-	-	-	-	-	-	1	-	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2414	CRITICAL CARE AND OPERATION THEATRE EQUIPMENT	3	0	0	3	100
Course Objectives	**The student should be made to:** • To offer clear understanding of various intensive care equipment and their working. • To understand the necessity of different operation theatre equipment. • To know about different dialyzers and ventilators.					

Unit-I	INTENSIVE CARE UNIT EQUIPMENT	(9)
Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer		
Unit-II	**CRITICAL CARE EQUIPMENT**	**(9)**
Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.		
Unit-III	**OPERATION THEATRE EQUIPMENT**	**(9)**
Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope.		
Unit-IV	**CENTRALISED SYSTEMS**	**(9)**
Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.		
Unit-V	**PATIENT SAFETY**	**(9)**
Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India PvtLtd,New Delhi, 2015
2	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012

REFERENCES:	
1	L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2	Antony Y.K.Chan,"Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
3	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Apply the knowledge acquired, in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations
CO2:	Suggest suitable surgical instruments and operational devices.
CO3:	Compare the various techniques for clinical diagnosis, therapy and surgery, and its recent methods
CO4:	Assess the merits of the operation theatre equipment based on its applications
CO5:	Design the devices for the particular application based on given specifications.

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	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	-	-
Avg.	3	2	1	1	1	-	-	-	-	-	-	-	-	-
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2415	HUMAN ASSIST DEVICES	3	0	0	3	100

Course Objectives

- To study the role and importance of machines that takes over the functions of the heart and lungs,
- To study various mechanical techniques that help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications

Unit-I	HEART LUNG MACHINE AND ARTIFICIAL HEART	(9)
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.		
Unit-II	**CARDIAC ASSIST DEVICES**	**(9)**
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.		
Unit-III	**ARTIFICIAL KIDNEY**	**(9)**
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.		
Unit-IV	**RESPIRATORY AND HEARING AIDS**	**(9)**
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.		
Unit-V	**RECENT TRENDS**	**(9)**
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2	John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004

REFERENCES:	
1	Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.
2	Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering" Marcel Dekker Inc New York 2004.
3	D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the principles and construction of artificial heart
CO2:	Understand various mechanical techniques that improve therapeutic technology
CO3:	Explain the functioning of the membrane or filter that cleanses the blood.
CO4:	Describe the tests to assess the hearing loss and development of wearable devices for the same.
CO5:	Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

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

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

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Mecheri, Salem Dt-636453, Tamilnadu

Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2416	ADVANCEMENTS IN HEALTHCARE TECHNOLOGY	3	0	0	3	100
Course Objectives	The student should be made to: • Understand the needs for wearable devices and the technology • Learn the concepts in digital health care and digital hospitals • Apply the tools in design, testing and developing digital health care equipment					

Unit-I	**DIGITAL HEALTH**	**(9)**
Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.		
Unit-II	**DIGITAL RADIOLOGY**	**(9)**
Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.		
Unit-III	**E-HEALTH**	**(9)**
E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology.		
Unit-IV	**M-HEALTH CARE AND WEARABLE DEVICES**	**(9)**
Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study		
Unit-V	**MODALITY AND STANDARDS FOR INTER-OPERABILITY**	**(9)**
Multimodality registration in daily clinical practice. Mobile healthcare. Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care. Case study.		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	Christoph Thuemmler, Chunxue Bai, "Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare", Springer, 1st ed. 2017

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2	Wlater Hruby, "Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006

REFERENCES:	
1	Rick Krohn (Editor), David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.
2	Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
3	John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Interpret the need for digital methods of handling medical records
CO2:	Explain the digital radiology
CO3:	Modify the tools and methods for work flow in E-Health
CO4:	Identify the available technology for wearable healthcare devices
CO5:	Compare various standards for inter-operability of devices, quality and safety standards for developing healthcare 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	1	1	1	-	-	-	-	-	-	1	1	1
CO2	3	2	1	1	1	-	-	-	-	-	-	1	1	1
CO3	3	2	1	1	1	-	-	-	-	-	-	1	1	1
CO4	3	2	1	1	1	-	-	-	-	-	-	1	1	1
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	1
Avg.	3	2	1	1	1	-	-	-	-	-	-	1	1	1
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2417	**ROBOTICS IN MEDICINE**	**3**	**0**	**0**	**3**	100
Course Objectives	The objective of this course is to enable the student to: • Get introduced to the fundamental of robotics and position analysis • Learn about Parallel robots, different types of motions and force analysis • Know the basics of trajectory planning, Motion control systems and actuators • Have an insight into various sensors and vision systems • Be acquainted to Fuzzy control and Applications of Robotics in Medicine					

Unit-I	**FUNDAMENTALS AND POSITION ANALYSIS**	**(9)**
Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Forward and inverse kinematics, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Screw based robots, Position analysis of Articulated robot **Case studies**		
Unit-II	**PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS**	**(9)**
Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames **Case studies**		
Unit-III	**TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS**	**(9)**
Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction **Case studies**		
Unit-IV	**SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS**	**(9)**

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Sensor Characteristics, Position, Velocity, Acceleration, Force, Pressure and Torque, Microswitches, Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing, Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images, Heuristics, **Case studies**		
Unit-V	**FUZZY CONTROL AND APPLICATIONS IN MEDICINE**	**(9)**
Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nanobots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with teleoperated robots, Orthopedic surgery with cooperative robots. **Case studies**		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020
2	Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.

REFERENCES:	
1	Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2	Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3	Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4	Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the fundamental of robotics and position analysis
CO2:	Outline the functioning of parallel robots, different types of motions and force analysis.
CO3:	Portray the basics of trajectory planning, Motion control systems and actuators.
CO4:	Recognize and explain the use of various sensors and vision systems in robotics.
CO5:	Employ Fuzzy control in robotics and apply it to Robotics in Medicine

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2418	THERAPEUTIC EQUIPMENT	3	0	0	3	100
Course Objectives	• To learn the principles of cardiac assist devices. • To understand the need and use of extracorporeal devices, and the use of lasers in medicine. • To enable the students to gain knowledge on the working of therapeutic clinical equipment.					

Unit-I	CARDIAC AND RESPIRATORY THERAPY EQUIPMENT	(9)
Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter. Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.		
Unit-II	**BIOMECHANICAL THERAPEUTIC EQUIPMENT**	**(9)**
Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.		
Unit-III	**BODY CARE EQUIPMENT**	**(9)**
Skin Treatment: Ultrasonic spot remover, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.		
Unit-IV	**DENTAL CARE EQUIPMENT**	**(9)**
Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed hand piece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.		
Unit-V	**HEAT & PHOTON THERAPY EQUIPMENT**	**(9)**
High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.		

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Total No of Periods to be Taught	45 periods

TEXT BOOK:	
1	Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003
2	John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition.Wiley &s ons, Inc., NewYork. 2009

REFERENCES:	
1	Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000.
2	John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2000.
3	Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc
CO2:	Comprehend the principles of bodycare equipment
CO3:	Understand the operation of dental care equipment.
CO4:	Analyze the different types of therapies for suitable applications.
CO5:	Appreciate the application of lasers in biomedical 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	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	1	-	-
Avg.	3	2	1	1	-	-	-	-	-	-	-	1	-	-

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

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STREAM-IV
COMMUNICATION

Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2419	COMMUNICATION SYSTEMS	3	0	0	3	100
Course Objectives	**The student should be made to:** • To study the various analog and digital modulation techniques • To study the principles behind various error control coding • To study the various digital communication techniques					

Unit-I	**ANALOG MODULATION**	**(9)**
Amplitude Modulation – AM, DSBSC, SSBSC, VSB – Angle modulation – PM and FM –Modulators and Demodulators		
Unit-II	**RECEIVER CHARACTERISTICS**	**(9)**
Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems – Single tuned receivers – Super heterodyne receivers.		
Unit-III	**INFORMATION THEORY**	**(9)**
Measure of information – Entropy – Source coding theorem – Discrete memoryless channels – lossless, deterministic, noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon- Fano coding, Huffman Coding, run length coding, LZW algorithm.		
Unit-IV	**BANDPASS SIGNALING**	**(9)**
Geometric representation of signals – Correlator and matched filter – ML detection – generation and detection, PSD, BER of coherent BPSK, BFSK, QPSK – Principles of QAM – Structure of non- coherent receivers – BFSK, DPSK		
Unit-V	**ERROR CONTROL CODING TECHNIQUES**	**(9)**
Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes (CRC) – Convolutional codes – Viterbi decoding (Soft/Hard decision decoding).		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	B.P.Lathi, "Modern Digital and Analog Communication Systems'', Oxford University Press, 3rd Edition, 2007

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2	H Taub, D L Schilling, G Saha, "Principles of Communication Systems", TMH, 3rd Edition, 2007
3	S. Haykin , "Digital Communications", John Wiley, 2005

REFERENCES:	
1	H P Hsu, Schaum "Outline Series, Analog and Digital Communications", TMH, 2006
2	B.Sklar, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2:	Apply analog modulation techniques.
CO3:	Apply digital modulation techniques.
CO4:	Knowledge on various types of noises during transmission.
CO5:	Analyze various error control coding 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	-	-
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	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2420	WEARABLE DEVICES	3	0	0	3	100
Course Objectives	The student should be made to: • To know the hardware requirement of wearable systems • To understand the communication and security aspects in the wearable devices • To know the applications of wearable devices in the field of medicine					

Unit-I	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	(9)
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor.		
Unit-II	**SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES**	**(9)**
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Thermopiles.		
Unit-III	**WIRELESS HEALTH SYSTEMS**	**(9)**
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges-System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.		
Unit-IV	**SMART TEXTILE**	**(9)**
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration.		
Unit-V	**APPLICATIONS OF WEARABLE SYSTEMS**	**(9)**
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2	Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013

REFERENCES:	
1	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the concepts of wearable system.
CO2:	Explain the energy harvestings in wearable device.
CO3:	Use the concepts of BAN in health care.
CO4:	Illustrate the concept of smart textile
CO5:	Compare the various wearable devices in healthcare 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	1	1	2	-	-	1	-	-	-	1	-	-
CO2	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO3	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO4	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO5	3	2	1	1	2	-	-	1	-	-	-	1	-	-
Avg.	3	2	1	1	2	-	-	1	-	-	-	1	-	-

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2421	BODY AREA NETWORKS	3	0	0	3	100
Course Objectives	The student should be made to: • To know the hardware requirement of BAN • To understand the communication and security aspects in the BAN • To know the applications of BAN in the field of medicine					

Unit-I	INTRODUCTION	(9)
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.		
Unit-II	**HARDWARE FOR BAN**	**(9)**
Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.		
Unit-III	**WIRELESS COMMUNICATION AND NETWORK**	**(9)**
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.		
Unit-IV	**COEXISTENCE ISSUES WITH BAN**	**(9)**
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.		
Unit-V	**APPLICATIONS OF BAN**	**(9)**
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013
2	Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCES:	
1	Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
2	Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006.
3	Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2:	Design a BAN for appropriate application in medicine.
CO3:	Assess the efficiency of communication and the security parameters.
CO4:	Understand the need for medical device regulation and regulations followed in various regions.
CO5:	Extend the concepts of BAN for medical 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	2	-	-	1	-	-	-	1	-	-
CO2	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO3	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO4	3	2	1	1	2	-	-	1	-	-	-	1	-	-
CO5	3	2	1	1	2	-	-	1	-	-	-	1	-	-
Avg.	3	2	1	1	2	-	-	1	-	-	-	1	-	-

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2422	**VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE**	**3**	**0**	**0**	**3**	100
Course Objectives	The objective of this course is to enable the student to • Introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues • Understand virtual reality, augmented reality and using them to build Biomedical engineering applications • Know the intricacies of these platform to develop PDA applications with better optimality. • Learn the various applications of VR. • Learn the possibilities of implementing target-specific VR applications on mobile.					

Unit-I	**INTRODUCTION**	**(9)**
The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.		
Unit-II	**VR DEVELOPMENT PROCESS**	**(9)**
Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model management.		
Unit-III	**CONTENT CREATION CONSIDERATIONS**	**(9)**
Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment		
Unit-IV	**VR ON THE WEB & VR ON THE MOBILE**	**(9)**
JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics		
Unit-V	**APPLICATIONS**	**(9)**
Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2	Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

REFERENCES:	
1	Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
2	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
3	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016.
4	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Analyze and Design a system or process to meet given specifications with realistic engineering constraints.
CO2:	Identify problem statements and function as a member of an engineering design team.
CO3:	Analyze the implications and issues pertaining to VR
CO4:	Propose technical documents and give technical oral presentations related to design VR mini project results.
CO5:	Develop simple and portable VR applications using appropriate software

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2423	TELEHEALTH TECHNOLOGY	3	0	0	3	100
Course Objectives	• Learn the key principles for telemedicine and health • Understand telemedical technology. • Know telemedical standards, mobile telemedicine and it applications					

Unit-I	FUNDAMENTALS OF TELEMEDICINE	(9)
History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.		
Unit-II	TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE	(9)
Audio, video, still images, text and data, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.		
Unit-III	ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE	(9)
Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues.		
Unit-IV	PICTURE ARCHIVING AND COMMUNICATION SYSTEM	(9)
Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture		
Unit-V	APPLICATIONS OF TELEMEDICINE	(9)
Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery.		
Total No of Periods to be Taught	45 periods	

TEXT BOOK:	
1	Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 3. 2002
2	Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.

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REFERENCES:	
1	H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications" Wiley, New Jersey, 2010.
2	Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003
3	Keith J Dreyer, Amit Mehta, James H Thrall, "Pacs: A Guide to the Digital Revolution", Springer, New York, 2002.
4	Garrett Grolemund, *Hands–On Programming with R*, O'Reilly , 1 edition , 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	To analyze the benefits and limitations of telemedicine.
CO2:	To apply multimedia technologies in telemedicine.
CO3:	To explain protocols behind encryption techniques for secure transmission of data.
CO4:	To develop radiology based information system.
CO5:	To apply telemedicine in various healthcare domains.

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2424	MEDICAL INFORMATICS	3	0	0	3	100
Course Objectives	• To study the applications of information technology in health care management. • This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine					

Unit-I	INTRODUCTION TO MEDICAL INFORMATICS	(9)
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics		
Unit-II	**COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING**	**(9)**
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging-nuclear medicine, ultrasound imaging, computed X- ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance		
Unit-III	**COMPUTERISED PATIENT RECORD**	**(9)**
Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.		
Unit-IV	**COMPUTER ASSISTED MEDICAL DECISION-MAKING**	**(9)**
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine- computers in the care of critically ill patients, Computer aids for the handicapped		
Unit-V	**RECENT TRENDS IN MEDICAL INFORMATICS**	**(9)**
Virtual reality application in medicine, Virtual endoscopy, computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Compute resisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003.
2	R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill,2005

REFERENCES:	
1	Kathryn J. Hannah, Marion J Ball, "Health Informatics", 3rd Edition, Springer, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the structure and functional capabilities of Hospital Information System.
CO2:	Describe the need of computers in medical imaging and automated clinical laboratory.
CO3:	Articulate the functioning of information storage and retrieval in computerized patient record system.
CO4:	Apply the suitable decision support system for automated clinical diagnosis.
CO5:	Discuss the application of virtual reality and telehealth technology in medical industry.

Mapping of COs with POs and PSOs

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

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Department	BME	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2410	**BASICS OF MICROBIAL TECHNOLOGY**	3	0	0	3	100
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’sIllustratedBiochemistry”,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	PSO1	PSO2	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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2402	**RADIOLOGICAL EQUIPMENT**	3	0	0	3	100
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, Philadelpia, 1988 (Units I, II, III & IV).
2	R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.

REFERENCES:	
1	Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
2	B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C Barber, "Medical physics and biomedical Engineering", - CRC Press, 1999
3	Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4	P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the working principle of X-ray machine and its applications.
CO2:	Illustrate the principle of Computed Tomography (CT).
CO3:	Interpret the techniques used for visualizing various sections of the body using Magnetic Resonance Imaging (MRI).
CO4:	Demonstrate the applications of radionuclide imaging / nuclear medicine imaging.
CO5:	Outline the methods of radiation safety and protection.

Mapping of COs with POs and PSOs

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

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

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Department	BME	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2403	**FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY**	3	0	0	3	100
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. Recee and E.J. Simon "Essential Biology", VIIrd Edition, Pearson International, 2007

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understanding of cell at structural and functional level.
CO2:	Understand the central dogma of life and its significance.
CO3:	Comprehend the basic mechanisms of cell division.
CO4:	Study on the Cell cycle
CO5:	Students will learn about Central dogma

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO4	3	2	3	1	-	-	1	1	-	-	1	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	1	-	-	-
Avg.	3	2	3	1	-	-	-	-	-	-	1	-	-	-

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

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Department	BME	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2404	**HUMAN PHYSIOLOGY**	3	0	0	3	100
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.

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", 22nd 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2405	**LIFESTYLE DISEASES**	3	0	0	3	100
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)**
Coronoary 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMOE2406	**PATHOLOGY AND MICROBIOLOGY**	3	0	0	3	100
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

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, pO2 and pCO2, 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

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", 3rd Edition, Jaypee Medical Publication, 2010.

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 trents

Mapping of COs with POs and PSOs

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

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

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Department	AGRI	Programme Code & Name				Open to All Departments
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UAIOE2401	INTRODUCTION TO FOOD PROCESSING	3	0	0	3	100

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	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

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Department	AGRI	Programme Code & Name				Open to All Departments
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UAIOE2402	**TRADITIONAL INDIAN FOODS**	3	0	0	3	**100**

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
		L	T	P	C	
UAIOE2403	FUNDAMENTALS OF FOOD ENGINEERING	3	0	0	3	100

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, 7th 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	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
		L	T	P	C	
UAIOE2404	REMOTE SENSING CONCEPTS	3	0	0	3	100

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	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

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Department	AGRI	Programme Code & Name				Open to All Departments
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UAIOE2405	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT	3	0	0	3	100

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. *et al.* "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 recenttrend sinwater management.
CO5:	Understand the implementation hitches and the institutional frame works.

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

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Department	Chemical Engineering	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCHOE2401	**NANOMATERIALS AND APPLICATIONS**	3	0	0	3	100
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

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
		L	T	P	C	
UCHOE2402	POLYMER TECHNOLOGY	3	0	0	3	100
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	-

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Department	Chemical Engineering	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCHOE2403	**ENZYME ENGINEERING**	3	0	0	3	100
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.
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	-	-	-	-	-	-	-	-	-	-

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Department	Chemical Engineering	**Programme Code & Name**	Open to all Departments

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCHOE2404	**Bio Energy Resources**	3	0	0	3	100
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 comparision 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCHOE2405	**CHEMICAL PROCESS SAFETY**	3	0	0	3	100
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	CIVIL	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2401	ARCHITECTURAL HERITAGE OF INDIA	3	0	0	3	100
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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2402	BUILDING PLANNING AND CONSTRUCTION	3	0	0	3	100
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 ashlars 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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2403	ELEMENTARY CIVIL ENGINEERING	3	0	0	3	100
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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2404	ENERGY AND ENVIRONMENT	3	0	0	3	100
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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2405	GLOBAL WARMING AND CLIMATE CHANGE	3	0	0	3	100
Course Objectives	● To explain the causes and effects of global warming and climate change. ● To promote awareness of mitigation strategies and sustainable solutions.					

Unit-I	EARTH'S CLIMATE SYSTEM	(9)
Role of ozone in environment – Ozone layer – Ozone depleting gases – Greenhouse gases and its sources – Green House Effect, Radiative Effects of Greenhouse Gases -The Hydrological Cycle – Green House Gases and Global Warming – Effects and causes of Global Warming, Carbon Cycle.		
Unit-II	**ATMOSPHERE AND ITS COMPONENTS**	**(9)**
Importance of Atmosphere – Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere - Composition of the atmosphere - Atmospheric stability -Temperature profile of the atmosphere - Lapse rates- Temperature inversion - effects of inversion on pollution dispersion.		
Unit-III	**OBSERVED CHANGES AND ITS CAUSES**	**(9)**
Causes of Climate change – Change of Temperature in the environment - Melting of ice Pole-sea level rise - Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.		
Unit-IV	**OBSERVED CHANGES AND ITS CAUSES**	**(9)**
Climate change and Carbon credits – CDM- Initiatives in India - Kyoto Protocol - Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India		
Unit-V	**CLIMATE CHANGE AND MITIGATION MEASURES**	**(9)**
Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding - Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste(MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Kandarp Tarkeshprasad Vaishnav., Climate Change Solutions, Global Warming Solutions & Innovative Ideas For Construction of World Development, Notion Press, Chennai, First Edition, 2018
2	Vivian Moritz., Climate Change and Global Warming, Syrawood Publishing House, New York, First Edition, 2017

REFERENCES:	
1	Marie Antonette and Chloe Marechal., Climate Change Past, Present & Future, Wiley-Blackwell, New Jersey, First Edition, 2015.
2	Empereur Raymond., Global Warming and Climate Change, Litfire Publishing, Atlanta, First Edition, 2017.
3	Agarwal S.K., Global Warming and Climate Change Past, Present & Future, Ashish Publishing House, New Delhi, First Edition, 2004.
4	https://onlinecourses.swayam2.ac.in/arp19_ap55/preview

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Outline the concept of the causes and effects of global warming
CO2:	Summarize about physical and chemical characteristics of atmosphere
CO3:	Identify the causes and effects of climate change
CO4:	Infer the agreements took place among the countries regarding climate change
CO5:	Summarize about the concept of mitigation measures against climate change

Mapping of COs with POs and PSOs

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

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

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Department	CIVIL	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCEOE2406	INTRODUCTION TO DISASTER MANAGEMENT AND MITIGATION	3	0	0	3	100
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	CSE	Programme Code & Name	OPEN TO ALL DEPARTMENTS

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSOE2401	Introduction to C Programming	2	0	2	3	100

Course Objectives

- Understand the basic structure and syntax of C programming language.
- Develop logical thinking and problem-solving skills.
- Apply control structures, functions, and arrays.
- Understand pointers, structures, and file handling.
- Gain practical experience through lab exercises.

Unit-I	INTRODUCTION TO C PROGRAMMING	(6)

History and Features of C-Structure of C Program-Character Set, Tokens, Keywords, -Identifiers-Constants and Variables-Data Types (int, float, char, double)-Operators: Arithmetic, Relational, Logical, Assignment-Expressions and Precedence-Input and Output Functions (printf, scanf).

Unit-II	CONTROL STATEMENTS	(6)

Decision Making: if, if-else, nested if, switch-case -Looping: for, while, do-while-Nested loops Jump Statements: break, continue, goto-Applications of loops.

Unit-III	FUNCTIONS	(6)

Function Definition and Declaration-Types of Functions-Recursion-Storage Classes: auto, static, extern, register-Parameter Passing: Call by Value, Call by Reference.

Unit-IV	ARRAYS AND STRINGS	(6)

One Dimensional Arrays - Two Dimensional Arrays - Matrix Operations-String Declaration and Initialization-String Functions: strlen, strcpy, strcat, strcmp-Applications of Arrays and Strings.

Unit-V	POINTERS, STRUCTURES AND FILE HANDLING	(6)

Pointers and Pointer Arithmetic-Pointers with Arrays and Functions-Structures and Unions-File Handling: fopen, fclose, fprintf, fscanf, fgets, fputs-File Modes and Applications.

Total No of Periods to be Taught	30 Periods

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

REFERENCES:	
1	YashavantKanetkar, 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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Department	CSE	Programme Code & Name	OPEN TO ALL DEPARTMENTS

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSOE2402	Introduction to Data Structures	2	0	2	3	100
Course Objectives	• To understand fundamental data structures. • To analyze and design algorithms. • To implement linear and non-linear data structures. • To evaluate performance of algorithms. • To apply data structures in problem solving.					

Unit-I	Introduction to Data Structures	(6)
Definition and Classification of Data Structures-Abstract Data Types (ADT)-Algorithm -Analysis: Time and Space Complexity-Asymptotic Notations: Big-O, Theta, Omega-Recursion and its applications.		
Unit-II	**Linear Data Structures**	**(6)**
Arrays and their operations-Linked Lists: Singly, Doubly, Circular-Stack ADT: Operations and Applications-Queue ADT: Linear Queue, Circular Queue, Deque-Applications of Stacks and Queues.		
Unit-III	**Searching and Sorting**	**(6)**
Linear Search and Binary Search-Sorting Techniques: Bubble, Selection, Insertion-Divide and Conquer: Merge Sort, Quick Sort-Hashing: Hash Functions, Collision Handling-Performance Analysis of Searching and Sorting.		
Unit-IV	**Trees**	**(6)**
Tree ADT and Terminologies-Binary Trees and Traversals (Inorder, Preorder, Postorder)-Binary Search Trees-AVL Trees-Heaps and Priority Queues.		
Unit-V	**Graphs**	**(6)**
Graph ADT and Representations-Graph Traversals: BFS and DFS-Directed Acyclic Graphs (DAG)-Shortest Path Algorithms-Minimum Spanning Trees.		
Total No of Periods to be Taught	**30 Periods**	

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TEXT BOOK:	
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson, 2nd Edition, 1997.
2	Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia, 1976.

REFERENCES:	
1	Seymour Lipschutz, Data Structures, Schaum's Outline, McGraw Hill, 2011.
2	Reema Thareja, Data Structures Using C, Oxford University Press, 2014.
3	YedidyahLangsam, Moshe Augenstein, Data Structures Using C and C++, Pearson.

List of Exercises/Experiments	
1. Implement array operations.	
2. Implement singly linked list operations.	
3. Implement doubly and circular linked lists.	
4. Implement stack operations using array/linked list.	
5. Implement queue operations (linear and circular)	
6. Implement searching algorithms (linear, binary).	
7. Implement sorting algorithms (bubble, selection, insertion).	
8. Implement divide and conquer sorting (merge, quick sort).	
9. Implement tree traversals.	
10.Implement graph traversals (BFS, DFS).	
Total No of Periods to be Taught	**30 Periods**

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COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain basic data structures concepts.
CO2:	Apply linear data structures.
CO3:	Implement searching and sorting techniques.
CO4:	Analyze trees and graphs.
CO5:	Design efficient algorithms using data structures.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Turbo C Compiler	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	0	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	0	2	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	3	3	3	2	0	0	0	0	0	1	3	3	3
CO5	3	3	3	3	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.8	2.2	1.6	2	0	0	0	0	0	1.2	3	2.8	2.2
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	CSE	Programme Code & Name	OPEN TO ALL DEPARTMENTS

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSOE2403	Data Science Fundamentals	2	0	2	3	100

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

TEXT BOOK:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCES:	
1	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
2	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.

List of Exercises/Experiments
1. Download, install and explore the features of Python for data analytics
2. Working with Numpy arrays.
3. Working with Pandas data frames.
4. Basic plots using Matplotlib.
5. Statistical and Probability measures a) Frequency distributions b) Mean, Mode, Standard Deviation c) Variability d) Normal curves e) Correlation and scatter plots f) Correlation coefficient g) Regression.
6. Use the standard benchmark data set for performing the following: a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b) Bivariate Analysis: Linear and logistic regression modelling.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.
Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

Total No of Periods to be Taught	30 Periods

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COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Gain knowledge on data science process.
CO2:	Perform data manipulation functions using Numpy and Pandas.
CO3:	Understand different types of machine learning approaches.
CO4:	Perform data visualization using tools.
CO5:	Handle large volumes of data in practical scenarios.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Idle Python (latest version)	
3.	Jupyter Notebook	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	3	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	2	2	1	3	0	0	0	0	0	1	3	3	2
CO5	3	3	3	3	3	0	0	0	0	0	2	3	3	3
Avg.	3	2.6	2.2	1.4	2.4	0	0	0	0	0	1.2	3	2.8	2

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

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Department	CSE	Programme Code & Name	OPEN TO ALL DEPARTMENTS

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSOE2404	Introduction of Data Analytics	2	0	2	3	100

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**

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: Glocalized Sustainable Development Goals, Neha Sharma, Santanu Ghosh, MonodeepSaha, Springer, 2021.
2	The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017.
3	Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 2012.

List of Exercises/Experiments	
1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.	
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files.	
3. Implement of Matrix Multiplication with Hadoop Map Reduce.	
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	
5. Installation of Hive along with practice examples.	
6. Installation of HBase, Installing thrift along with Practice examples.	
7. Practice importing and exporting data from various databases.	
Total No of Periods to be Taught	**30 Periods**

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COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the fundamental concepts of data analytics in the areas that plays major role within the realm of data science.
CO2:	Explain and exemplify the most common forms of data and its representations.
CO3:	Understand and apply data pre-processing techniques.
CO4:	Illustrate various visualization methods for different types of data sets and application scenarios.
CO5:	Understand application and ethics of Data Science.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.NO	**DESCRIPTION OF EQUIPMENT**	**REQUIRED NUMBERS**
1.	Windows 11 requires a modern 64-bit processor (1 GHz or faster, 4 GB RAM, 64 GB+ storage)	30
2.	Idle Python (latest version)	
3.	Jupyter Notebook	

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	1	3	2	1
CO2	3	3	2	1	2	0	0	0	0	0	1	3	3	2
CO3	3	3	3	2	2	0	0	0	0	0	1	3	3	2
CO4	3	2	2	1	3	0	0	0	0	0	1	3	3	2
CO5	3	3	2	2	2	1	1	1	0	0	2	3	3	3
Avg.	3	2.6	2	1.2	2	0.2	0.2	0.2	0	0	1.2	3	2.8	2
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	CSE	Programme Code & Name	OPEN TO ALL DEPARTMENTS

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCSOE2405	Artificial Intelligence and Machine Learning Fundamentals	2	0	2	3	100

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**
		L	T	P	C	
UCSOE2406	IOT CONCEPTS AND APPLICATIONS	2	0	2	3	100

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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THE KAVERY ENGINEERING COLLEGE

An Autonomous institution approved by AICTE, New Delhi, Affiliated to Anna university Chennai
Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B
Mecheri, Salem Dt-636453, Tamilnadu

Department	ECE	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2401	INDUSTRIAL ELECTRONICS	3	0	0	3	100
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

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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Department	ECE	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2402	IMAGE PROCESSING AND COMPUTER VISION	3	0	0	3	100
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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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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2403	4G / 5G COMMUNICATION NETWORKS	3	0	0	3	100
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.

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2404	WIRELESS COMMUNICATION	3	0	0	3	100
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)

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

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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B
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Department	ECE	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2405	EMBEDDED AND REAL TIME SYSTEMS	3	0	0	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 CIC++", 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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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
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Department	ECE	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2406	ROBOTICS AND ITS INDUSTRIAL APPLICATIONS	3	0	0	3	100
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*.

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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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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2407	INDUSTRIAL IOT	3	0	0	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 I0T in the real world scenario.					

Unit-I	**INTRODUCTION AND ARCHITECTURE OF IoT**	**(9)**
Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.		
Unit-II	**INDUSTRIAL IoT**	**(9)**
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking		
Unit-III	**IIOT ANALYTICS**	**(9)**
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop		
Unit-IV	**IOT SECURITY**	**(9)**
Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT		
Unit-V	**CASE STUDY**	**(9)**
Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries		
Total No of Periods to be Taught	**45 Periods**	

TEXT BOOK:	
1	Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017

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REFERENCES:	
1	Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Cap
2	"Industrial Internet of Things: Cyber manufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the basic concepts and Architectures of Internet of Things.
CO2:	Understand various IoT Layers and their relative importance.
CO3:	Realize the importance of Data Analytics in IoT.
CO4:	Study various IoT platforms and Security
CO5:	Understand the concepts of Design Thinking.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	-	2	3	2	2
CO2	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO3	3	2	2	2	2	2	-	-	-	-	2	3	3	2
CO4	3	2	3	2	3	2	-	-	-	-	2	3	3	2
CO5	3	3	3	3	3	3	-	-	-	-	1	3	2	3
Avg.	3	2.3	2.4	2.3	2	2.3	-	-	-	-	1.8	3	2.6	2.3

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Department	ECE	**Programme Code & Name**	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2408	SENSORS AND TRANSDUCERS	3	0	0	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, Inclinometers		
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.

REFERENCES:	
1	Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2	John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	List common types of sensor and actuators used in vehicles.
CO2:	Design measuring equipment's for the measurement of pressure force, temperature and flow
CO3:	Generate new ideas in designing the sensors and actuators for automotive application
CO4:	Understand the operation of the sensors, actuators and electronic control
CO5:	Design temperature control actuators for vehicles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO2	3	2	2	2	1	2	-	-	-	-	2	3	3	2
CO3	3	2	2	2	2	2	-	-	-	-	2	3	3	2
CO4	3	2	2	2	3	2	-	-	-	-	2	3	3	2
CO5	3	2	3	3	3	3	-	-	-	-	2	3	2	3
Avg.	3	2	2.3	2.3	2	2.3	-	-	-	-	2	3	2.8	2.3

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

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Mecheri, Salem Dt-636453, Tamilnadu

Department	ECE	Programme Code & Name	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UECOE2409	SPACE SCIENCE	3	0	0	3	100
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 Environmentand 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.

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	EEE	**Programme Code & Name**	Open to All Departments

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

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

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Department	EEE	**Programme Code & Name**	Open to All Departments

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 PHASEINDUCTION 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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TEXT BOOK:	
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

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Department	EEE	**Programme Code & Name**	Open to All Departments

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, Theramal 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 ELECTRICALENERGY**	**(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**

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TEXT BOOK:	
1	Wadhwa, C.L."Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd, 2003.
2	Dr.Uppal S.L.and Prof.S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3	Energy Efficiency in Electric Utilities, BEE Guide Book,2010

REFERENCES:	
1	Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.
2	OpenshawTaylor.E,"UtilizationofElectricalEnergyinSIUnits",OrientLongmanPvt.Ltd, 2003.
3	Gupta.J.B,"UtilizationofElectricPowerandElectricTraction",S.K.KatariaandSons, 2002.
4	Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

COURSE OUTCOMES:
On completion of the course, the students will be able to

CO1:	To understand them a in aspects of generation, utilization and conservation.
CO2:	To understand them a in aspects of illuminations
CO3:	To realize the appropriate type of electric supply system as well as to evaluate the performance of a traction unit.
CO4:	To understand the main aspects of Traction and method of heating
CO5:	To evaluate domestic wiring connection and debug any faults occurred

Mapping of COs with POs and PSOs

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

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2404	**POWER ELECTRONICS AND DRIVES**	3	0	0	3	**100**
Course Objectives	• Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics • Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers • Detailed knowledge on Classifications, structure, operating principle of dc choppers. • Introduction to different types of Inverters , their principle of operation and waveform control • Overview on dc and ac drives and their control using power electronic circuits.					

Unit-I	**POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS**	**(9)**
Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits.		
Unit-II	**CONTROLLED RECTIFIERS AND AC CONTROLLERS**	**(9)**
Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cyclo converters, Matrix converters		
Unit-III	**DC TO DC CONVERTERS**	**(9)**
Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators		
Unit-IV	**INVERTERS**	**(9)**
Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters		
Unit-V	**DRIVES AND CONTROL**	**(9)**
Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only)– Introduction to vector control of AC drives..		
Total No of Periods to be Taught		**45**

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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.

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	Bimbra, 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

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2405	**ELECTRICAL ESTIMATION AND COSTING**	3	0	0	3	**100**
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.					

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**

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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
2	Electrical Installation buildings Indian Standard Institution, IS:2032

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

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Department	EEE	**Programme Code & Name**	Open to All Departments

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**
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**

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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
3	W.Bolton, Programmable Logic Controllers, 6th Edition, Elseiver, 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

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2407	**INTRODUCTION TO CONTROL ENGINEERING**	3	0	0	3	**100**
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.					

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**

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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
3	John J.D., Azzo Constantine, H. and HoupisSttuart, 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	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

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Department	EEE	**Programme Code & Name**	Open to All Departments

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**
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					

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**

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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
2	Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 1998
3	Partab. H., “Art and Science and Utilisation of Electrical Energy”, DhanpatRai and Sons, 1994.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Derive the heating and cooling curve and study the various classes of duty and Selection of power rating
CO2:	Understand the working principle of DC &AC motors and their characteristics and its braking methods
CO3:	Understand the Starting methods of DC &AC motors
CO4:	Understand the Concepts of speed control in DC motors
CO5:	Understand the Concepts of speed control in AC motors

Mapping of COs with POs and PSOs

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

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

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2409	**ENERGY CONSERVATION AND MANAGEMENT**	3	0	0	3	**100**
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					

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**

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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

REFERENCES:	
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													

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2410	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING**	3	0	0	3	**100**
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**

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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

REFERENCES:	
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													

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Department	EEE	**Programme Code & Name**	Open to All Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	**T**	**P**	**C**	
UEEOE2411	**INTRODUCTION TO EMBEDDED SYSTEMS**	3	0	0	3	**100**
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**

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TEXT BOOK:	
1	Lyla B Das, Embedded systems: An Integrated Approach, 1st Ed., Pearson, 2013

REFERENCES:	
1	Shibu, K.V., Introduction to Embedded Systems, 1st Ed., TMH, 2009
2	KantaRao B, Embedded Systems, 1st Ed., PHI
3	Frank Vahid& Tony Givargis, Embedded System Design, 2nd Edition, John Wiley,

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	learn about the general principles of computer architecture
CO2:	learn about the working of a simple embedded system and embedded system applications
CO3:	learn the hardware aspects of embedded systems
CO4:	Understand the sensors, ADCs and actuators used in embedded systems
CO5:	Understand the real world examples of embedded systems

Mapping of COs with POs and PSOs

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

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

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Department	Mechanical	**Programme Code & Name**	Open to All Departments

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UMEOE2401	**REVERSE ENGINEERING**	2	0	2	3	100
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, Katheryn, 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

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UMEOE2402	**NON DESTRUCTIVE TESTING**	**2**	**0**	**2**	**3**	**100**

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

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UMEOE2403	**ADDTIVE MANUFACTURUING TECHNOLOGY**	**2**	**0**	**2**	**3**	**100**
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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Department	Mechanical	Programme Code & Name	Open to all Departments

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMEOE2404	ENERGY TECHNOLOGY	3	0	0	3	100

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

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMEOE2405	RENEWABLE ENERGY TECHNOLOGIES	3	0	0	3	100
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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UMEOE2406	INTRODUCTION TO INDUSTRIAL ENGINEERING	3	0	0	3	100

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

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UMEOE2407	**FIBRE REINFORCED PLASTICS**	**3**	**0**	**0**	**3**	**100**

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

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
UMEOE2408	**NANO TECHNOLOGY AND ITS APPLICATIONS**	**3**	**0**	**0**	**3**	**100**

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	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2425	**FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT**	**3**	**0**	**0**	**3**	100
Course Objectives	• To understand the global trends and development methodologies of various types of products and services • To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems • To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification • To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics • To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.					

Unit-I	BASICS OF PRODUCT DEVELOPMENT	(9)
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.		
Unit-II	**REQUIREMENTS AND SYSTEM DESIGN**	**(9)**
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.		
Unit-III	**DESIGN AND TESTING**	**(9)**
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.		
Unit-IV	**SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**	**(9)**

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Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal		
Unit-V	**BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY**	**(9)**
The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.		
Total No of Periods to be Taught		**Total: 45 periods**

TEXT BOOK:	
1	Book specially prepared by NASSCOM as per the MoU.
2	Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.

REFERENCES:	
1	Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2	Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3	Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Define, formulate, and analyze a problem
CO2:	Solve specific problems independently or as part of a team
CO3:	Gain knowledge of the Innovation & Product Development process in the Business Context
CO4:	Work independently as well as in teams
CO5:	Manage a project from start to finish

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2426	MEDICAL DEVICE DESIGN	3	0	0	3	100
Course Objectives	• Introduce the Medical device standards and requirements. • Illustrate the design procedure of medical devices. • Outline the quality assessment in design. • Describe about the design realization. • Understand the validation and verification of various medical devices					

Unit-I	NEEDS FINDING AND CONCEPT GENERATION	(9)
Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - Tools, Documents and Deliverables.		
Unit-II	**MEDICAL DEVICES STANDARDS AND REQUIREMENTS**	**(9)**
FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.		
Unit-III	**DESIGN AND TESTING**	**(9)**
Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.		
Unit-IV	**TESTING AND VALIDATION**	**(9)**
I Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.		
Unit-V	**DESIGN TRANSFER AND MANUFACTURING**	**(9)**
Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.		
Total No of Periods to be Taught		**Total: 45 periods**

TEXT BOOK:	
1	Zenios, Makower and Yock, —Biodesign – The process of innovating medical technologies‖, Canbridge University Press, 2009
2	Theodore R. Kucklick , The Medical Device R&D Handbook, Second Edition, CRC Press, 2012

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REFERENCES:	
1	Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design,2nd edition, 2005.
2	Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.
3	Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau'Handbook of Human Factors in Medical Device Design', CRC press,2010.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Define the medical devices standards and requirements.
CO2:	Summarise the concept of medical device development.
CO3:	Recall the engineering design and project metrics.
CO4:	Demonstrate the testing and validation of medical equipment.
CO5:	Interpret the various design transfer and manufacturing methods

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

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2427	**PATIENT SAFETY, STANDARDS AND ETHICS**	**3**	**0**	**0**	**3**	100
Course Objectives	• To understand the importance of patient safety against electrical hazards • To explain the patient safety laws and regulations • To understand the standards and testing of patient • To know the patient safety specialities in clinical • To know about the health care organization					

Unit-I	**EFFECTS OF ELECTRICITY**	**(9)**
Physiological effects of electricity - important susceptibility parameters - microshock - macroshock hazards -patients electrical environment - isolated power system - conductive surfaces		
Unit-II	**PATIENT SAFETY LAWS AND REGULATIONS**	**(9)**
Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety Legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse-Event Reporting, Patient safety Goals and standards, The Quality Assessment and performance Improvement rule.		
Unit-III	**STANDARDS AND TESTING**	**(9)**
Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system		
Unit-IV	**PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES**	**(9)**
Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.		
Unit-V	**MEDICAL ETHICS**	**(9)**
Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.		
Total No of Periods to be Taught		**Total: 45 periods**

REFERENCES:

1.	John G.Webster, "Medical Instrumentation Application and design", 4th edition, Wiley India PvtLtd, New Delhi, 2015.
2.	Liam Donaldson,Walter Ricciardi, "Textbook of patient safety and clinical Risk management", Springer.
3.	Fay A. Rozovsky, James R. Woods, Jr, " The Handbook of Patient Safety Compliance", 2016

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COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Outline the importance of patient safety against electrical hazards.
CO2:	Brief out the patient safety laws and regulations
CO3:	Explain the standards and testing of patient
CO4:	Understand the concept of the patient safety specialties in clinical
CO5:	know about various health care 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	3	2	1	1	1	-	-	-	-	1	-	-	-	
CO2	3	2	1	1	1	-	-	-	-	1	-	-	-	
CO3	3	2	1	1	1	-	-	1	1	1	-	-	-	
CO4	3	2	1	1	1	-	-	1	1	1	-	-	-	
CO5	3	2	1	1	1	-	-	1	1	1	-	-	-	
Avg.	3	2	1	1	1	-	-	1	1	1	-	-	-	

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2428	MEDICAL DEVICE REGULATIONS	3	0	0	3	100
Course Objectives	• To study the regulation of medical devices, process of development, ethical and quality considerations. • To learn the various ISO standards of quality and risk management for regulatory purposes • To explore the process of approval and marketing of medical devices. • To comprehend the regulatory process for medical devices in India, US, and EU. • To familiarize with clinical evaluation and investigation of medical devices.					

Unit-I	MEDICAL DEVICE REGULATIONS	(9)
History of medical device regulation, regulatory affairs professional's roles, required competencies, medical device classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users. Differentiating medical devices IVDs and combination products from that of pharmaceuticals.		
Unit-II	**ISO STANDARDS**	**(9)**
ISO 13485:2016: Requirements for regulatory purposes: Quality Management Systems, certification process. ISO 14971: Application of Risk management to medical Devices.		
Unit-III	**IEC, REGULATORY SYSTEMS IN USA & EU**	**(9)**
IEC international standards and conformity assessment for medical devices, Good submission process, medical device regulatory system in the USA and European Union.		
Unit-IV	**INDIAN REGULATORY SYSTEM**	**(9)**
India: Medical device regulatory system: market environment, functions undertaken by DGGI, central government, FDA and state governments, guidance documents, details of key regulators, IMDRF and CDSCO, regulatory overview in India, product registration on conformity assessment, quality system regulation, technical material and labeling requirements, commercial aspects, upcoming regulation changes.		
Unit-V	**CLINICAL TRIALS AND DIGITAL REGULATIONS**	**(9)**
Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor and Society, Case Studies.		
Total No of Periods to be Taught		**Total: 45 periods**

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REFERENCES:	
1.	Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2.	Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998.
3.	Product Safety in the European Union by Gabor Czitan, Attila Gutassy, Ralf Wilde, TU V Rheinl and Akademia, 2008.

COURSE OUTCOMES:	
On completion of the course, the students will be able to	
CO1:	Define and explain the basic concepts of medical device regulations.
CO2:	Decipher the meaning of ISO standards from a regulatory perspective.
CO3:	Explain US-FDA, IEC and European regulations.
CO4:	Discuss regulations in India
CO5:	Explain the regulatory aspects of clinical trials and digital alternatives

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	-	-	-	
CO2	3	2	1	1	1	-	-	-	-	1	-	-	-	
CO3	3	2	1	1	1	-	-	1	1	1	-	-	-	
CO4	3	2	1	1	1	-	-	1	1	1	-	-	-	
CO5	3	2	1	1	1	-	-	1	1	1	-	-	-	
Avg.	3	2	1	1	1	-	-	1	1	1	-	-	-	
1 – Slight, 2 – Moderate, 3 –Substantial , BT – Bloom's Taxonomy														

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2429	**MEDICAL INNOVATION AND ENTREPRENEURSHIP**	**3**	**0**	**0**	**3**	100
Course Objectives	• To learn fundamentals of entrepreneurship • To apply the methods of entrepreneurship in medical field • To evaluate the medical devices and market trends					

UNIT – I	**CREATIVITY, INNOVATION AND IPR**	**9**
The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.		
UNIT – II	**SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP**	**9**
Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.		
UNIT – III	**NEW VENTURE**	**9**
Developing an Effective Business Model: The Importance of a Business Model – Starting a small- scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study.		
UNIT – IV	**FINANCING THE NEW VENTURE AND GLOBALIZATION**	**9**
Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.		
UNIT – V	**MARKETING FUNCTION**	**9**
Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA. 2010
2.	Vasant Desai, —The Dynamics of Entrepreneurial Development and Managementll, Himalaya Publishing House, 2010.

REFERENCES:	
1.	Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016.
2.	Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014.
3.	Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western.
4.	Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe the role of biomedical engineers in entrepreneurship
CO2:	Interpret the background for biomedical engineers in entrepreneurship
CO3:	Acquire the skills and techniques required towards innovation
CO4:	Categorize the resources and funding agencies and judge the right product based on market needs
CO5:	Compile and quantify the opportunities and challenges

Mapping of COs with POs and PSOs															
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
CO2	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
CO3	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
CO4	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
CO5	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
Avg.	3	2	1	1	1	-	-	2	-	1	-	1	-	-	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy															

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2430	**RAPID PROTOTYPING**	**3**	**0**	**0**	**3**	100

Course Objectives	**The student should be made to:** • Learn the need and fundamentals of rapid prototyping • Understand the concepts of design and assembling of various parts • Study the process and material selection for UV and Laser based AM • Investigate the process of fused deposition moulding and sheet lamination • Explore droplet formation and beam deposition process

UNIT – I	**INTRODUCTION**	**9**
Overview –Need -Development of Additive Manufacturing Technology -Principle – AM Process Chain-Classification –Rapid Prototyping-Rapid Tooling –Rapid Manufacturing – Applications- Benefits –Case studies.		
UNIT – II	**DESIGN FOR ADDITIVE MANUFACTURING**	**9**
Design tools: Data processing -CAD model preparation –Part orientation and support structure generation – Model slicing –Tool path generation-Design for Additive Manufacturing: Concepts and objectives-AM unique capabilities –DFAM for part quality improvement-Customised design and fabrication for medical applications.		
UNIT – III	**PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES**	**9**
Photo polymerization: SLA-Photo curable materials –Process -Advantages and Applications. Powder Bed Fusion: SLS-Process description –powder fusion mechanism –Process Parameters – Typical Materials and Application. Electron Beam Melting.		
UNIT – IV	**EXTRUSION BASED AND SHEET LAMINATION PROCESSES**	**9**
Extrusion Based System: FDM-Introduction –Basic Principle –Materials –Applications and Limitations –Bio extrusion. Sheet Lamination Process: LOM-Gluing or Adhesive bonding –Thermal bonding.		
UNIT – V	**PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES**	**9**
Droplet formation technologies –Continuous mode –Drop on Demand mode –Three Dimensional Printing – Advantages –Bioplotter -Beam Deposition Process: LENS-Process description –Material delivery –Process parameters –Materials –Benefits –Applications.		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, World Scientific Publishers, Third edition, 2010.
2.	Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.

REFERENCES:	
1.	Ian Gibson, David W.Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2.	Tom Page Design for Additive Manufacturing, LAP Lambert Academic Publishing, 2012.
3.	Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	Demonstrate the basics of Additive manufacturing.	
CO2:	Design and assembly of various parts for the desired task.	
CO3:	Explain the process involved in laser and UV based AM	
CO4:	Illustrate the process of fused deposition moulding and sheet lamination	
CO5:	Support design and manufacturing, case studies relevant to mass customized	

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2431	BIOMECHANICS	3	0	3	3	100
Course Objectives	The objective of this course is to enable the student to • Learn the fundamental concepts of the principles of mechanics. • Understand the basics of bio fluid mechanics. • Review the mechanical properties of musculoskeletal elements. • Study the biomechanics of joints and implants. • Learn the application of biomechanics into modelling and ergonomic design.					

UNIT – I	INTRODUCTION TO MECHANICS	9
Introduction – Scalars and vectors, Statics –Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics – Linear motion, Newton's laws of motion, Velocity and acceleration, Kinematics – Models, Transducers Constitutive equations –Non- viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid		
UNIT – II	**BIOFLUID MECHANICS**	**9**
Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for Non- Newtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.		
UNIT – III	**MUSCULOSKELETAL MECHANICS**	**9**
Constitutive equation of viscoelasticity – Maxwell, Voight and Kelvin models, anisotropy, Hard Tissues – Structure, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modelling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle, Bone fracture mechanics, Implants for bone fractures.		
UNIT – IV	**BIOMECHANICS OF JOINTS AND IMPLANTS**	**9**
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.		
UNIT – V	**MODELLING AND ERGONOMICS**	**9**
Introduction to Finite Element Analysis, finite element analysis of lumbar spine; models for voice biomechanics, Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted and whole-body vibrations.		
		Total: 450periods

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TEXT BOOK:
Y.C. Fung, Bio-Mechanics- Mechanical Properties of Tissues, Springer-Verlag, 1998.
Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009

REFERENCES:
Sheraz S. Malik and Shahbaz S. Malik, Orthopaedic Biomechanics Made Easy,Cambridge University Press, 2015.
Jay D. Humphrey, Sherry De Lange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.
Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand and apply the principles of mechanics, kinetics and kinematics in the context of biological systems Appraise the basics of biofluid mechanics as applied to heart valve design and blood vessel models.
CO2:	Describe the basics of biofluid mechanics as applied to heart valve design and blood vessel models.
CO3:	Describe the mechanical properties of musculoskeletal elements to develop the mathematical models of joints and implants.
CO4:	Apply the knowledge of biomechanics into analysis of human joints and motion
CO5:	Apply Biomechanics principles to “real-world” problem and describe their impact on health, safety, society, environment as well as underlying legal and ethical considerations.

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2432	REHABILITATION ENGINEERING	3	0	0	3	100

Course Objectives

The objective of this course is to enable the student to

- Explain the need for medical aids.
- Understand the sensory rehabilitation systems.
- Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- Understand virtual reality in rehabilitation
- Have an understanding of rehabilitation medicine and advocacy.

UNIT – I	**INTRODUCTION TO REHABILITATION**	**9**

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT – II	**ENGINEERING CONCEPTS IN SENSORY AUGMENTATION AND SUBSTITUTION**	**9**

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution.

UNIT – III	**ORTHOPEDIC PROSTHETICS AND ORTHOTICS**	**9**

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT – IV	**VIRTUAL REALITY**	**9**

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT – V	**REHABILITATION MEDICINE AND ADVOCACY**	**9**

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

Total No of Periods to be Taught	**Total: 45 periods**

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TEXT BOOK:	
1.	Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press, 2000.
2.	Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006.

REFERENCES:	
1.	Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.
2.	Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3.	Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000
4.	Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis,1988.

COURSE OUTCOMES:

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

CO1:	Summarize the key terminologies used by the rehabilitation team.
CO2:	Illustrate Engineering Concepts in Sensory & Motor rehabilitation.
CO3:	Design different orthotics and prosthetics for rehabilitation applications.
CO4:	Summarize the need of virtual reality tools for different aids.
CO5:	Appraise the legal aspects for building rehabilitation aids for the needed people.

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2433	PHYSIOLOGICAL MODELLING	3	0	0	3	100
Course Objectives	• To explain the application of Physiological models and vital organs. • To Formulate the methods and techniques for analysis and synthesis of dynamic models • To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software. • To describe nonlinear models of physiological systems • To compute the Simulation of physiological systems					

UNIT – I	INTRODUCTION TO PHYSIOLOGICAL MODELING	9
Approaches to modelling: The technique of mathematical modelling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modelling. Introduction to physiology (homeostasis, cell biology) Modelling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.		
UNIT – II	**MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM**	**9**
Dynamic systems and their control, modelling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.		
UNIT – III	**NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS**	**9**
Nonparametric Modelling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modelling - Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.		
UNIT – IV	**COMPARTMENTENTAL PHYSIOLOGICAL MODEL**	**9**
Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modelling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical modelling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.		
UNIT – V	**SIMULATION OF PHYSIOLOGICALSYSTEMS**	**9**
Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Michel C Khoo, "Physiological Control Systems -Analysis, simulation and estimation", Prentice Hall of India, 2001.
2.	Marmarelis, "Nonlinear Dynamic Modeling of Physiological Systems", Wiley-IEEE Press,2004.

REFERENCES:	
1.	Benjamin C Kuo, "Automatic control systems", Tenth Edition, McGraw-Hill Education, 2017.
2.	MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,"Advanced Computational Methods in Life System Modeling and Simulation", *Springer*,2017
3.	DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, Wiley-IEEE Press, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the application of Physiological models
CO2:	Describe the methods and techniques for analysis and synthesis of Linear and dynamic system
CO3:	Develop differential equations to describe the compartmental physiological model
CO4:	Describe Nonlinear models of physiological systems
CO5:	Illustrate the Simulation of physiological 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	1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	-	-
Avg.	3	1	1	1	1	-	-	-	-	-	-	-	-	-

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2434	ASSISTIVE TECHNOLOGY	3	0	0	3	100
Course Objectives	**The student should be made to:** • To know the hardware requirement various assistive devices • To understand the prosthetic and orthotic devices • To know the developments in assistive technology					

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	COMPARTMENTENTAL PHYSIOLOGICAL MODEL	9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.		
UNIT – V	RECENT TRENDS	9
Transcutaneous electrical nerve stimulator, bio-feedback		
Total No of Periods to be Taught		**Total: 45 periods**

TEXT BOOK:	
1.	Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006
2.	Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010

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REFERENCES:	
1.	Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2.	Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3.	3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323- 662116
4.	Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2:	Describe the underlying principles of hemodialyzer machine.
CO3:	Indicate the methodologies to assess the hearing loss.
CO4:	Evaluate the types of assistive devices for mobilization.
CO5:	Explain about TENS and biofeedback 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	1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	-	-
Avg.	3	1	1	1	1	-	-	-	-	-	-	-	-	-
1 – Slight, 2 – Moderate, 3 – Substantial , BT – Bloom's Taxonomy														

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2435	ERGONOMICS	3	0	0	3	100

Course Objectives	• To get exposed to principles of visual capabilities. • To learn the mechanics of muscle physiology and significance of rest cycle. • To learn spatial compatibility and the relation between control orders and control response. • To know about the measurements and proportions of the human body. • To be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNIT – I	**VISUAL AND AUDITORY ERGONOMICS**	**9**
Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.		
UNIT – II	**MUSCLE PHYSIOLOGY**	**9**
Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.		
UNIT – III	**CONTROLS AND DISPLAYS**	**9**
Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task		
UNIT – IV	**ANTHROPOMETRY**	**9**
Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.		
UNIT – V	**CASE STUDIES**	**9**
Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc. Case Study 2: Biomedical Application, Design optimization of Medical Equipment.		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Pascale Carayon, "Handbook of Human Factors and Engineering", Second Edition, CRC Press, 2011
2.	Martin Helander, "Guide to Human Factors and Ergonomics", Second Edition, CRC Press,2005

REFERENCES:
Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press2007.
George Kanawaty, "Introduction to work study", ILO, 3rd edition, Oxford & IBH publishing, 2001
Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, 2005.

COURSE OUTCOMES:

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

CO1:	Understand principles of ergonomics.
CO2:	Understand the significance of posture
CO3:	Learn about tracking tasks.
CO4:	Learn about ergonomics and its implications to various domain
CO5:	Perform case studies on electronic instruments and medical 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	1	1	1	1	-	-	-	-	-	-	-	1	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	1	-
Avg.	3	1	1	1	1	-	-	-	-	-	-	-	1	-

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2436	**HAPTICS**	**3**	**0**	**0**	**3**	100
Course Objectives	**The objective of this course is to enable the student to** ● Expose to basic principles of Haptics and their property. ● Give knowledge on machines in haptics. ● Learn types of sensors and actuators. ● Understand basic concepts of human locomotion, biomechanical analysis using Finite Element Analysis.					

UNIT – I	**HUMAN HAPTICS**	**9**
Somatosensory System; Motor System, Muscle Physiology; Haptics Psychophysical experiments		
UNIT – II	**MACHINE HAPTICS**	**9**
Design Haptic devices; Human factors involved;		
UNIT – III	**HAPTIC SENSORS AND ACTUATORS**	**9**
Barriers in human haptics; Ergonomics.		
UNIT – IV	**COMPUTATIONAL HAPTICS**	**9**
Haptic Rendering; Rigid bodies, Deformable bodies, Stability Rendering effects, Human performance and evaluation; Biomechanics of manipulation; Neuromuscular Models.		
UNIT – V	**HAPTICS FOR MEDICAL APPLICATIONS**	**9**
Applications: Telemedicine; Rehabilitation; Medical Simulations for education		
Total No of Periods to be Taught		**Total: 45 periods**

TEXT BOOK:

1.	Kay M.Stanney, Handbook of Virtual Environments: Design, Implementation, and Applications, Lawrence Erlbaum Associates, Publications. N. I. Durlach and A. S. Mavor, eds., Virtual Reality: Scientific and Technological Challenges, National Academy Press, Washington, D.C., 1994.
2.	G.C. Burdea, Force and Touch Feedback for Virtual Reality, John Wiley & Sons, 1996

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REFERENCES:	
1.	Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012.
2.	Marc J. Madou, Fundamentals of Micro fabrication: the Science of miniaturization,CRC Press, 2002.
3.	Nadim Maluf and Kirt Williams, An introduction to Microelectro Mechancial Systems Engineering, Second Edition, Artech House Inc, MA,2004.
4.	Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey,USA,2006.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain the laws of principles of haptics for human
CO2:	Discuss the behavior of machines in haptics
CO3:	Analyse the suitable sensor and actuator for haptics
CO4:	Identify suitable computation for haptics
CO5:	Describe the finite element analysis, design the work station depending upon the haptics

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2437	BIOSIGNAL PROCESSING	3	0	0	3	100
Course Objectives	The student should be made to: • To study the characteristics of different biosignals • To learn linear and non-linear filtering techniques to extract desired information • To understand various techniques for automated classification and decision making to aid diagnosis					

UNIT – I	BIOSIGNAL AND SPECTRAL CHARACTERISTICS	9
Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.		
UNIT – II	**TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION**	**9**
Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.		
UNIT – III	**ADAPTIVE FILTERING AND WAVELET DETECTION**	**9**
Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.		
UNIT – IV	**BIOSIGNAL CLASSIFICATION AND RECOGNITION**	**9**
Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.		
UNIT – V	**TIME FREQUENCY AND MULTIVARIATE ANALYSIS**	**9**
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA,ICA		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, 2nd Edition, 2016.
2.	Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.

REFERENCES:	
1.	Kayvan Najarian and Robert Splerstor, "Biomedical signals and Image processing'', CRC – Taylor and Francis, New York, 2nd Edition, 2012.
2.	K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
3.	D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques'', Tata McGraw-Hill Publishing Co. Ltd, 2005.
4.	John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications'', Taylor& Francis Inc, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Preprocess the Bio signals.
CO2:	Analyze bio signals in time domain & to estimate the spectrum.
CO3:	Apply wavelet detection techniques for biosignal processing.
CO4:	Classify Biosignals using neural networks and statistical classifiers.
CO5:	Extract the features using multivariate component 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	1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	-	-
Avg.	3	1	1	1	1	-	-	-	-	-	-	-	-	-

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2438	COMPUTER VISION FOR BIOMEDICAL ENGINEERS	3	0	0	3	100
Course Objectives	• To review image processing techniques for computer vision. • To understand various features and recognition techniques • To learn about histogram and binary vision • Apply three-dimensional image analysis techniques real world applications of computer vision algorithms					

UNIT – I	INTRODUCTION	9
Computer Vision ,What is Computer Vision - Low-level, Mid-level, High-level ; Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective.		
UNIT – II	**FEATURE EXTRACTION**	**9**
Feature Extraction -Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space 69 Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters.		
UNIT – III	**COLOR IMAGES, BINARY VISION**	**9**
Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms- Back-projection - k-means Clustering – Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology – Connectivity.		
UNIT – IV	**3D VISION**	**9**
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction		
UNIT – V	**MOTION**	**9**
Introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion– spline-based motion- optical flow – layered motion.		
		Total: 45periods

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TEXT BOOK:	
1.	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011
2.	Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

REFERENCES:	
1.	Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.
2.	E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
3.	Concise Computer Vision: An Introduction into Theory and Algorithms, by Reinhard Klette, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Explain low level processing of image and transformation techniques applied to images.
CO2:	Develop the feature extraction and object recognition methods
CO3:	Apply Histogram transform for detection of geometric shapes like line, ellipse and objects.
CO4:	Illustrate 3D vision process and motion estimation techniques.
CO5:	Apply vision techniques to real time applications.

Mapping of COs with POs and PSOs

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2439	SPEECH AND AUDIO SIGNAL PROCESSING	3	0	0	3	100
Course Objectives	The objective of this course is to enable the student to • Provide students with basic knowledge about speech production and hearing. • Understand time-frequency analysis concepts. • Learn fundamentals of audio coding and transform coders. • Understand time and frequency domain methods for speech processing. • Study linear predictive analysis of speech.					

UNIT – I	MECHANICS OF SPEECH AND AUDIO	9
Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Nonsimultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.		
UNIT – II	**TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS**	**9**
Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree- Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre- echo Control Strategies.		
UNIT – III	**AUDIO CODING AND TRANSFORM CODERS**	**9**
Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4AudioCoding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.		
UNIT – IV	**TIME AND FREQUENCY DOMAIN**	**9**
Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods **HOMOMORPHIC SPEECH ANALYSIS:** Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.		
UNIT – V	**LINEAR PREDICTIVE ANALYSIS**	**9**
Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.		

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Total No of Periods to be Taught	Total: 45 periods

TEXT BOOK:	
1.	Rabiner. L. R and Schaffer. R. W., "Digital Processing of Speech signals", Prentice Hall, 1978
2.	Andreas Spanias, Ted Painter, Venkatraman AttiWayne Tomasi, "Audio signal processing and coding", John Wiley & Sons, 2007

REFERENCES:	
1.	Udo Zölzer , Digital Audio Signal Processing, A John Wiley& sons Ltd Publication, Second Edition, 2008.
2.	Mark Kahrs, Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustics", KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT,
3.	Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
4.	Martin S. Roden, "Analog and Digital Communication System", Prentice Hall of India, 3rd Edition, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Examine auditory models to design perceptual audio quality measure.
CO2:	Design analysis-by-synthesis model for speech perception.
CO3:	Analyze and design algorithms for speech and audio coding.
CO4:	Analyze and design algorithms for extracting parameters from the speech signal.
CO5:	Implement pitch detection and formant analysis in speech signals.

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

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2440	**FUNDAMENTALS OF HEALTHCARE ANALYTICS**	**3**	**0**	**0**	**3**	100
Course Objectives	• Understand the statistical methods for the design of biomedical research. • Comprehend the fundamental of mathematical and statistical theory in the application of Healthcare. • Apply the regression and correlation analyze in the healthcare data. • Understand the Meta analysis and variance analysis. • Interpret the results of the investigational methods					

UNIT – I	**INTRODUCTION**	**9**
Introduction, Computers and bio statistical analysis, Introduction to probability, likelihood & odds, distribution variability. Finding the statistical distribution using appropriate software tool like R/ Python.		
UNIT – II	**STATISTICAL PARAMETERS**	**9**
Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing - single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python		
UNIT – III	**REGRESSION AND CORRELATION ANALYSIS**	**9**
Regression model, evaluating the regression equation, correlation model, correlation coefficient. Finding regression, correlation for the data using appropriate software like R / Python		
UNIT – IV	**ANALYSIS OF VARIANCE**	**9**
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment. Testing the variance using appropriate software tool like R / Python		
UNIT – V	**CASE STUDIES**	**9**
Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.		
Total No of Periods to be Taught		**Total: 45 periods**

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REFERENCES:	
1.	Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2ndEdition, 2018.
2.	Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014
3.	Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006.

TEXT BOOK:	
1.	Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley & Sons Publication, 10th Edition, 2013.
2.	Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001
3.	Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN:978- 1-305-26892-0

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Define the new and existing statistical methodology for their research problem.
CO2:	Explain p- values for different statistical test
CO3:	Analyze the biomedical research data and able to report the study results.
CO4:	Enumerate the Meta analysis and variance analysis. 96
CO5:	Describe problems of human health and disease for the interest of advancing the public's Health

Mapping of COs with POs and PSOs

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

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

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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2441	**BRAIN COMPUTER INTERFACE AND APPLICATIONS**	**3**	**0**	**0**	**3**	100
Course Objectives	**The student should be made to:** • To understand the basic concepts of brain computer interface • To study the various signal acquisition methods • To study the signal processing methods used in BCI					

UNIT – I	**INTRODUCTION TO BCI**	**9**
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.		
UNIT – II	**ELECTROPHYSIOLOGICAL SOURCES**	**9**
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.		
UNIT – III	**FEATURE EXTRACTION METHODS**	**9**
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods– AR,MA,ARMA models – PCA – Linear and Non-Linear Features.		
UNIT – IV	**FEATURE TRANSLATION METHODS**	**9**
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.		
UNIT – V	**APPLICATIONS OF BCI**	**9**
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.		
Total No of Periods to be Taught		**Total: 45 periods**

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TEXT BOOK:	
1.	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.

REFERENCES:	
1.	R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
2.	Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Describe BCI system and its potential applications.
CO2:	Analyze event related potentials and sensory motor rhythms.
CO3:	Compute features suitable for BCI.
CO4:	Design classifier for a BCI system.
CO5:	Implement BCI for various applications.

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UBMPE2442	**BIOMETRICS**	**3**	**0**	**0**	**3**	100

Course Objectives	• To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues. • To understand the general principles of design of biometric systems and the underlying trade-offs. • To study the technologies of fingerprint, iris, face and speech recognition. • To study of evaluation of biometrics systems.

UNIT – I	**INTRODUCTION TO BIOMETRICS**	**9**
Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.		
UNIT – II	**FINGERPRINT TECHNOLOGY**	**9**
History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.		
UNIT – III	**FACE RECOGNITION AND HAND GEOMETRY**	**9**
Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry – scanning – Feature Extraction – classification.		
UNIT – IV	**IRIS RECOGNITION**	**9**
Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde's approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.		
UNIT – V	**VOICE SCAN AND MULTIMODAL BIOMETRICS**	**9**
Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).		

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Total No of Periods to be Taught	Total: 45 periods

TEXT BOOK:	
1.	James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011
2.	Paul Reid, "Biometrics for Network Security", Pearson Education, 2004

REFERENCES:	
1.	Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system'', Springer, 2003.
2.	L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition", CRC Press, 1st Edition, 1999.
3.	John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Demonstrate the principles of biometric systems.
CO2:	Develop fingerprint recognition technique.
CO3:	Design face recognition and hand geometry system.
CO4:	Design iris recognition system.
CO5:	Develop speech recognition and multimodal biometric 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	1	1	2	-	-	1	-	-	-	-	1	-
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	-
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	-
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	-
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	-
Avg.	3	2	1	1	2	-	-	1	-	-	-	-	1	-

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

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Mecheri, Salem - 636 453.

Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2401	FINANCIAL MANAGEMENT	3	0	0	3	100
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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2402	**FUNDAMENTALS OF INVESTMENT**	3	0	0	3	100
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 FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.		
Unit-II	**FIXED INCOME SECURITIES**	**(9)**
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default trisk and credit rating.		
Unit-III	**APPROACHES TOEQUITYANALYSIS**	**(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 andactivism.		
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	-

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2403	BANKING, FINANCIAL SERVICES AND INSURANCE	3	0	0	3	100
Course Objectives	• Understand the Banking system in India. • Grasp how banks raise their sources and how they deploy it • Understand the development in banking technology • Understand the financial services in India • Understand the insurance Industry in India					

Unit-I	INTRODUCTION TO INDIAN BANKING SYSTEM	(9)
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.		
Unit-II	**MANAGING BANK FUNDS/ PRODUCTS**	**(9)**
Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.		
Unit-III	**DEVELOPMENT IN BANKING TECHNOLOGY**	**(9)**
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money – forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.		
Unit-IV	**FINANCIAL SERVICES**	**(9)**
Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking.		
Unit-V	**INSURANCE**	**(9)**
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2	Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
3	Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017 .

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the structure, functions, and key regulations of the Indian banking system, including types of banking and accounts.
CO2:	Analyze bank fund management, various financial products, negotiable instruments, and current issues like NPAs and bank M&As.
CO3:	Examine advancements in banking technology, electronic payment systems, and cybersecurity in the context of RBI regulations.
CO4:	Evaluate various financial services in India such as NBFCs, leasing, mutual funds, venture capital, and merchant banking.
CO5:	Understand the concept and evolution of insurance in India, including regulatory frameworks and policy lifecycle management.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	2	-	-	-	3	2	-
CO2	3	3	3	2	3	2	-	2	-	-	-	3	3	-
CO3	2	2	3	3	3	2	2	2	2	-	-	2	3	-
CO4	3	3	3	2	2	-	-	1	1	-	-	3	3	-
CO5	2	2	2	3	2	3	2	1	1	2	2	2	2	-
Avg.	2	3	3	3	1	2.5	2	2	2	2	2	3	3	-

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2404	INTRODUCTION TO BLOCK CHAIN AND ITS APPLICATIONS	3	0	0	3	100
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 Madisetti, “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:	Analyzecryptocurrencies 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2405	FINTECH PERSONAL FINANCE AND PAYMENTS	3	0	0	3	100
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:TheBeginner'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:	AnalyzeFinTech and RegTech regulatory environments globally and domestically, including AI-driven compliance and fraud detection.

Mapping of COs with POs and PSOs

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

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

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THE KAVERY ENGINEERING COLLEGE

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Accredited by NAAC with A+ grade & Recognised by UGC under section 2f & 12B
Mecheri, Salem Dt-636453, Tamilnadu

Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2406	**INTRODUCTION TO FINTECH**	**3**	**0**	**0**	**3**	100
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:	AnalyzeFinTech 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2407	FOUNDATIONS OF ENTREPRENEURSHIP	3	0	0	3	100
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 Entreprenrship to Economic Development.		
Unit-II	**BUSINESS OWNERSHIP & ENVRIONMENT**	**(9)**
Types of Business Ownership – BuinessEnvrionemental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Reosurces Mobilisation-Basics of Managing Finance- Esentials 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 entrepreneruship - 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 opportunites in Industries relating to Technopreneurship.
CO4:	Learn about applications of tehnopreneurship 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2408	TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS	3	0	0	3	100
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	Haldar, 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 entreprenerus.''

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2409	**CREATIVITY & INNOVATION IN ENTREPRENEURSHIP**	3	0	0	3	100
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 Inovation 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, SudanshuBhushan, 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 inteligence 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 effecientlty 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**	

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2410	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	3	0	0	3	100
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 DISTRIBTUION MANAGEMENT**	**(9)**
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.		
Unit-V	**CONTEMPORARY ISSUES IN MARKETING MANAGEMENT**	**(9)**

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Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.

Total No of Periods to be Taught	**45 periods**

REFERENCES:	
1	Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2	Marketing Management , Philip Kortler and Kevin Lane Keller, PHI 15th Ed, 2015.
3	Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4	Marketing Management- An Indian perspective, Vijay PrakashAnand, Biztantra, Second edition, 2016.
5	Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.
6	Marketing Management- text and Cases, Dr.C.B.Gupta&Dr.N.Rajan Nair, 17th edition, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Have the awareness of marketing management process.
CO2:	Understand the marketing environment.
CO3:	Acquaint about product and pricing strategies.
CO4:	Knowledge of promotion and distribution in marketing management.
CO5:	Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.

Mapping of COs with POs and PSOs

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2411	**HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS**	**3**	**0**	**0**	**3**	100
Course Objectives	• To introduce the basic concepts, structure and functions of human resource management for entrepreneurs. • To create an awareness of the roles, functions and functioning of human resource department. • To understand the methods and techniques followed by Human Resource Management practitioners.					

Unit-I	**INTRODUCTION TO HRM**	**(9)**
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.		
Unit-II	**HUMAN RESOURCE PLANNING**	**(9)**
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends.		
Unit-III	**RECRUITMENT AND SELECTION**	**(9)**
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.		
Unit-IV	**TRAINING AND EMPLOYEE DEVELOPMENT**	**(9)**
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices.		
Unit-V	**CONTROLLING HUMAN RESOURCES**	**(9)**
Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends.		
Total No of Periods to be Taught		**45 periods**

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REFERENCES:	
1	Gary Dessler and BijuVarkkey, Human Resource Management, 14e , Pearson, 2015.
2	Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
3	David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014.
4	R. Wayne Mondy, Human Resource Management, Pearson , 2015.
5	Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012.
6	John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	To understand the Evolution of HRM and Challenges faced by HR Managers.
CO2:	To learn about the HR Planning Methods and practices.
CO3:	To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO4:	To known about the methods of Training and Employee Development.
CO5:	To comprehend the techniques of controlling human resources in organisations.

Mapping of COs with POs and PSOs

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2412	FINANCING NEW BUSINESS VENTURES	3	0	0	3	100
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 quity financing. • To empower the learners towards fund rasiing for new ventures effectively.					

Unit-I	ESSENTIALS OF NEW BUSINES 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 Dent 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 Hilld 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:	Understanf 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**	-

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2413	PRINCIPLES OF PUBLIC ADMINISTRATION	3	0	0	3	100
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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2414	CONSTITUTION OF INDIA	3	0	0	3	100

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.

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2415	**PUBLIC PERSONNEL ADMINISTRATION**					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**	

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2416	**ADMINISTRATIVE THEORIES**					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	CroziorM : 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2417	**INDIAN ADMINISTRATIVE SYSTEM**	**3**	**0**	**0**	**3**	100
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 DistrictCollector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government		
Unit-III	**PANCHAYATI RAJ AND URBAN LOCAL GOVERNANCE: 73RD AND 74TH CONSTITUTIONAL AMENDMENTS**	**(9)**
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992.		
Unit-IV	**COALITION POLITICS, INTEGRITY, AND VIGILANCE IN INDIAN ADMINISTRATION**	**(9)**
Coalition politics in India, Integrity and Vigilance in Indian Administration.		
Unit-V	**CORRUPTION AND ANTI-CORRUPTION INSTITUTIONS**	**(9)**
Corruption – Ombudsman, Lok Pal &LokAyuktha.		
Total No of Periods to be Taught	**45 periods**	

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REFERENCES:	
1	S.R. Maheswari : Indian Administration.
2	Khera. S.S : Administration in India.
3	Ramesh K. Arora : Indian Public Administration.
4	T.N. Chaturvedi : State administration in India.
5	Basu, D.D : Introduction to the Constitution of India.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understand the evolution and constitutional framework of Indian administration and key constitutional authorities.
CO2:	Explain the roles of district administration and local government officials in governance and development.
CO3:	Analyze the features and impacts of the 73rd and 74th Constitutional Amendments on local self-government.
CO4:	Evaluate coalition politics, integrity, and vigilance in Indian administration.
CO5:	Assess anti-corruption mechanisms including Ombudsman, Lok Pal, and LokAyuktha.

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2418	**PUBLIC POLICY ADMINISTRATION**	**3**	**0**	**0**	**3**	100
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	PSO2	PSO3
CO1	3	3	0	2	0							3	3	
CO2	3	3	2	0	0							3	3	
CO3	3	3	2	2	0							3	3	
CO4	3	3	0	2	2							3	3	
CO5	3	3	2	2	2							3	3	
Avg.	**3**	**3**	**2**	**2**	**2**							**3**	**3**	

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

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2419	**STATISTICS FOR MANAGEMENT**	**3**	**0**	**0**	**3**	100
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, MasoodH.Siddiqui, Sanjay Rastogi, Statistics forManagement, Pearson Education, 8th Edition, 2017.
2	Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
3	T N Srivastava and ShailajaRego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
4	Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
5	David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	To facilitate objective solutions in business decision making.
CO2:	To understand and solve business problems.
CO3:	To apply statistical techniques to data sets, and correctly interpret the results.
CO4:	To develop skill-set that is in demand in both the research and business environments.
CO5:	To enable the students to apply the statistical techniques in a work setting.

Mapping of COs with POs and PSOs

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

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

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2420	DATAMINING FOR BUSINESS INTELLIGENCE	3	0	0	3	100
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, Ïntroduction 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
CMG2421	**HUMAN RESOURCE ANALYTICS**	**3**	**0**	**0**	**3**	100
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 ANLYTICS 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2422	**MARKETING AND SOCIAL MEDIA WEB ANALYTICS**	**3**	**0**	**0**	**3**	100
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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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2423	OPERATION AND SUPPLY CHAIN ANALYTICS	3	0	0	3	100
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	**WAREHOUSINGDECISIONS**	**(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 PathAlgorithms, 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 an 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, PearsonEducation,2014.
2	Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jaya raman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, PearsonEducation,2013

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3	Anna Na gurney, Min Yu, Amir H.Masoumi, LadimerS.Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4	MuthuMathirajan,ChandrasekharanRajendran, SowmyanarayananSadagopan, ArunachalamRavindran, ParasuramBalasubramanian, 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 Solutionsin Business Decision Making Under Conditions Of certainty, risk and uncertainty.

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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCMG2424	**FINANCIAL ANALYTICS**	**3**	**0**	**0**	**3**	100
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 byPavelRyzhov.
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.

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2425	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	3	0	0	3	100
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, timberand FRP- No/Low cement concrete - Recycled and manufactured aggregate- RoleofQCand 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", Principlesand Practice Publisher:BelhavenPress,ISBN:1852930039.
7	Munier N, "Introduction to Sustainability", Springer2005
8	Sharma, "Sustainable SmartCities In India: Challenges And Future Perspectives", SPRINGER, 2022.
9	Ralph Horne, Tim Grant, KarliVerghese, 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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2426	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	3	0	0	3	100
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 *Vs.* a biotic factors in an ecosystem - Ecosystem processes -Ecological services and agriculture-Problems associated with industrial agriculture/food systems- Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems		
Unit-II	**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	**EVALUATINGSUSTAINABILITY INAGROECOSYSTEMS**	**(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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2427	**SUSTAINABLE BIO MATERIALS**	**3**	**0**	**0**	**3**	100

Course Objectives	● To Impart knowledge of bio materials and their properties ● To learn about Fundamentals aspects of Biopolymers and their applications ● To learn about bio ceramics and biopolymers ● To introduce the students about metals as biomaterials and their usage a simplants ● To make the students understand the significance of bio nanomaterials and its applications.

Unit-I	INTRODUCTIONTOBIOMATERIALS	(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 CERAMICSAND BIOCOMPOSITES**	**(9)**
General properties-Bio ceramics-Silicate glass-Alumina (Al2O3)-Zirconia(ZrO2)-Carbon- Calcium phosphates(CaP)-Resorbable Ceramics-surface reactive ceramics-Biomedical Composites-Polymer Matrix Compsite (PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite(MMC)–glass ceramics- Ortho pedic implants-Tissue engineering scaffolds		
Unit-IV	**METALSAS 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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Meatllic 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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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2428	**MATERIALS FOR ENERGY SUSTAINABILITY**	**3**	**0**	**0**	**3**	100
Course Objectives	• Tofamiliarize thestudentsabout thechallengesanddemandsofenergysustainability • Toprovidefundamentalknowledge aboutelectrochemical devices andthe materialsused. • Tointroducethe students to various typesof fuelcell • Toenable students toappreciatenovel materialsand their usagein photovoltaicapplication • Tointroducestudentstothebasicprinciplesofvarioustypes Super capacitorsandthe materialsused					

Unit-I	SUSTAINABLE ENERGY SOURCES	(9)
Introduction toenergy demandandchallengesahead–sustainablesourceofenergy (wind,solar etc.)–electrochemicalenergy systems forenergy harvestingandstorage–materials for sustainableelectrochemicalsystemsbuilding–Indiacentricsolutionsbasedonlocally available materials–Economics ofwindandsolarpowergeneratorsvs.conventionalcoalplants–Nuclear energy		
Unit-II	**ELECTRO CHEMICAL DEVICES**	**(9)**
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery(Li-ionbattery,Sodium-ionbattery,Li-Sbattery,Li-O_2 battery,NickelCadmium,Nickel Metal Hydride)–Primary battery (Alkaline battery, Zinc-Carbon battery)–Materials for battery (Anode materials– Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials–S,$LiCoO_2$, $LiFePO_4$,$LiMn_2O_4$)–Electrolytes forLithium-ion battery (ethylene carbonate andpropylene carbonatebased)		
Unit-III	**FUEL CELLS**	**(9)**
Principleofoperationof fuelcells–typesoffuelcells(Protonexchange membrane fuelcells, alkaline fuel cell, direct methanol fuelcells, direct borohydride fuelcells, phosphoricacid fuelcells, solid oxide fuelcells,andmoltencarbonate fuelcells)–Thermodynamicsof fuelcell–Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum,Platinumalloys,carbonsupportedplatinumsystemsand metaloxidesupportedplatinum catalysts)–Anatomyoffuelcells(gasdiffusionlayer,catalystlayer,flow fieldplate, current conductors, bipolarplates and mono polarplates).		
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)Se_2 solarcells–CadiumTelluridesolarcells–dyesensitizedsolarcells–Perovskitesolarcells–Measurementandcharacterizationofsolarcells-Materialsusedinsolarcells(metallicoxides,CNTfilms,graphene,OD fullerenes,single-multiwalledcarbonnanotubes,two-dimensional Graphene, organic orSmall molecule-basedsolarcellsmaterials-copper-phthalocyanineandperylenetetracarboxylicbis-benzine–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:	Studentswill acquireknowledge about energysustainability.
CO2:	Studentsunderstand theprinciples ofdifferentelectrochemical devices.
CO3:	Students learn about theworkingof fuelcellsandtheirapplication.
CO4:	Studentswill learnaboutvarious Photovoltaicapplications andthe materialsused.
CO5:	Thestudentsgainknowledgeondifferenttypesofsuper capacitorsandtheperformanceof various materials

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Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2429	**GREEN TECHNOLOGY**	**3**	**0**	**0**	**3**	100
Course Objectives	• Toacquireknowledgeongreensystemsandtheenvironment,energytechnologyand efficiency,andsustainability. • Toprovidegreen engineering solutionsto energydemand,reducedenergyfootprint.					

Unit-I	**PRINCIPLES OF GREEN CHEMISTRY**	**(9)**
HistoricalPerspectivesandBasicConcepts.The twelvePrinciplesofGreenChemistryandgreen engineering. Green chemistrymetrics-atomeconomy,Efactor, reactionmass efficiency,and other green chemistrymetrics, application of greenmetricsanalysis tosyntheticplans.		
Unit-II	**POLLUTION TYPES**	**(9)**
Pollution–types,causes,effects,andabatement. Waste–sourcesofwaste,differenttypesof waste,chemical, physical and biochemicalmethods ofwasteminimization andrecycling.		
Unit-III	**GREEN REAGENTS AND GREEN SYNTHESIS**	**(9)**
Environmentally benignprocesses-alternatesolvents-supercriticalsolvents,ionicliquids,wateras areactionmedium,energy-efficientdesign ofprocesses-photo,electro andsono chemical methods, microwave-assisted reactions		
Unit-IV	**DESIGNING GREEN PROCESSES**	**(9)**
Safedesign,processintensification,inprocessmonitoring.Safe productandprocessdesign– Design fordegradation,Real-timeAnalysisforpollutionprevention,inherently saferchemistry for accidentprevention		
Unit-V	**GREEN NANOTECHNOLOGY**	**(9)**
Nano materials forwatertreatment,nanotechnology forrenewableenergy,nanotechnology for environmental remediationandwastemanagement,nanotechnology products aspotential substitutesforharmful chemicals,environmentalconcernswith nanotechnology		
Total No of Periods to be Taught	**45 periods**	

TEXT BOOK:	
1	Greentechnologyanddesignfortheenvironment,SamirB.Billatos,NadiaA.Basaly,Taylor& Francis,Washington,DC,©1997
2	GreenChemistry –Anintroductorytext- M.Lancaster,RSC,2016

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3	Greenchemistrymetrics- Alexi Lapkinanddavid Constable (Eds),Wileypublications,2008

REFERENCES:	
1	Environmental chemistry,StanleyE Manahan, Taylorand Francis,2017

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Tounderstandtheprinciples of greenengineering andtechnology
CO2:	Tolearn aboutpollution usinghazardous chemicalsandsolvents
CO3:	Tomodifyprocesses and productstomakethem green andsafe.
CO4:	Todesignprocesses and productsusinggreen technology
CO5:	To understandadvanced technology ingreensynthesis

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2430	**ENVIRONMENTAL QUALITY MONITORINGANDANALYSIS**	**3**	**0**	**0**	**3**	100
Course Objectives	• Tounderstandand studythecomplexity of theenvironmentin relation topollutants generateddueto industrial activity. • Toanalyzethequalityoftheenvironmentalparametersandmonitorthesameforthe purpose ofenvironmental riskassessment.					

Unit-I	**ENVIRONMENTAL MONITORING AND STANDARDS**	**(9)**
Introduction- Environmental Standards-Classification ofEnvironmental Standards- Global EnvironmentalStandards- EnvironmentalStandardsinIndia-Ambientairquality standards-water quality standard-EnvironmentalMonitoring-Need forenvironmental monitoring-Concepts of environmental monitoring-TechniquesofEnvironmental Monitoring.		
Unit-II	**MONITORING OF ENVIRONMENTAL PARAMETERS**	**(9)**
CurrentEnvironmental Issues-GlobalEnvironmentalmonitoringprogramme-International conventions-ApplicationofEnvironmental Monitoring-AtmosphericMonitoring-screening parameters – Significance of environmental sampling- sampling methods – water sampling - samplingofambientair-samplingof fluegas.		
Unit-III	**ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING**	**(9)**
Classificationof InstrumentalMethod-AnalysisofOrganic Pollutantsby Spectrophotometric methods - Determinationofnitrogen,phosphorus and,chemicaloxygendemand(COD)insewage; Biochemicaloxygendemand(BOD)-Samplingtechniques forairpollution measurements;analysis ofparticulatesandairpollutantslikeoxidesofnitrogen,oxidesofsulfur,carbon monoxide, hydrocarbon; Introduction toadvancedinstrumentsforenvironmental analysis		
Unit-IV	**ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT**	**(9)**
Waterquality monitoringprogramme-nationalwaterquality monitoring-ParametersforNational WaterQuality Monitoring- monitoringprotocol; Processofriskassessment-hazardidentification-exposureassessment-dose-response assessment; riskcharacterization.		
Unit-V	**AUTOMATED DATA ACQUISITION AND PROCESSING**	**(9)**
DataAcquisition forProcessMonitoringandControl-TheDataAcquisitionSystem- OnlineData Acquisition,Monitoring, andControl-ImplementationofaDataManagementSystem-Review of ObservationalNetworks-Sensorsand transducers- classificationoftransducers-dataacquisition system-types of data acquisition systems- data management and quality control; regulatory overview.		
Total No of Periods to be Taught	**45 periods**	

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TEXT BOOK:	
1	Environmental monitoring Handbook, FrankR. Burden,©2002byTheMcGraw-HillCompanies, Inc.
2	Handbookofenvironmentalanalysis:chemical pollutantsintheair, water, soil,andsoildwastes/PradyotPatnaik, ©1997byCRC Press,Inc

REFERENCES:	
1	Environmentalmonitoring /editedbyG. BruceWiersma, ©2004byCRCPress LLC.
2	H.H.Willard, L. L. Merit, J. A. Dean andF. A. Settle, Instrumental MethodsofAnalysis, CBP Publishersand Distributors,NewDelhi,1988.
3	Heaslip,G. (1975) Environmental Data Handling. JohnWiley&Sons.NewYork.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Basicconceptsofenvironmentalstandards andmonitoring.
CO2:	Theambientair qualityandwater qualitystandards;
CO3:	The various instrumental methods and their principles for environmental monitoring
CO4:	The significance ofenvironmental standards in monitoring quality and sustainabilityoftheenvironment.
CO5:	Knowthestandardresearchmethodsthatareusedworldwideformonitoring theenvironment.

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

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2431	**INTEGRATED ENERGY PLANNINGFOR SUSTAINABLE DEVELOPMENT**	**3**	**0**	**0**	**3**	100
Course Objectives	• Tocreate awarenessontheenergyscenario of India with respect toworld • To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications ofenergyutilization • Familiarisationontheconceptof sustainable developmentanditsbenefits • Recognizethepotentialofrenewableenergysourcesanditsconversiontechnologiesfor attainingsustainable development • Acquaintingwith energypolicies and energyplanning forsustainable development					

Unit-I	**ENERGY SCENARIO**	**(9)**
Comparisonofenergyscenario–Indiaand World(energysources,generationmix, consumption pattern,T&Dlosses,energydemand,percapitaenergyconsumption)– energypricing–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)**
SustainableDevelopment:ConceptsandStakeholders,SustainableDevelopmentGoal (SDG)-Socialdevelopment:Poverty,conceptualissues andmeasures, impactofpoverty. Globalization and Economicgrowth-Economic development: Economic inequalities, Incomeandgrowth.		
Unit-IV	**RENEWABLE ENERGY TECHNOLOGY**	**(9)**
RenewableEnergy–SourcesandPotential–TechnologiesforharnessingfromSolar,Wind, Hydro,BiomassandOceans–Principle ofoperation, relative meritsanddemerits		
Unit-V	**ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT**	**(9)**
National&StateEnergy Policy-Nationalsolarmission-FrameworkofCentralElectricityAuthority-National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Roadmapforethanol blending,EnergyEfficiencyandEnergyMix		
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,awebsiteadministeredby BureauofEnergy Efficiency(BEE),a statutorybodyunder MinistryofPower,Governmentof India.2004
2	RobertRistirerand JackP.Kraushaar, "Energyand theenvironment",Willey,2005.
3	GodfreyBoyle,"RenewableEnergy,PowerforaSustainableFuture",OxfordUniversity Press, U.K., 2012
4	Twidell,J.W.&Weir A., "Renewable Energy Resources",EFNSponLtd., UK,2015.
5	DhandapaniAlagiri,EnergySecurityinIndiaCurrentScenario,TheICFAIUniversityPress, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understandtheworld and Indianenergyscenario
CO2:	Analyse energyprojects, itsimpact onenvironment and suggest control strategies
CO3:	Recognise the need of Sustainable development and its impact on human resource development
CO4:	Applyrenewable energytechnologiesforsustainable development
CO5:	Fathom Energypolicies and planningforsustainable development.

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Department	BME	Programme Code & Name	121-BE- BME

Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
UCES2432	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	3	0	0	3	100
Course Objectives	• To understand the types of energy sources, energy efficiency and environmental implications ofenergyutilization • Tocreate awarenessonenergyauditanditsimpacts • Toacquaintthetechniques adoptedforperformance evaluationofthermal utilities • Tofamiliarize ontheproceduresadoptedforperformanceevaluationofelectrical utilities • Tolearntheconcept ofsustainable development and theimplication ofenergyusage					

Unit-I	ENERGY AND ENVIRONMENT	(9)
Primaryenergysources-Coal,Oil,Gas–IndiaVsWorldwithrespecttoenergyproductionand consumption,Climate Change, GlobalWarming,Ozone Depletion,UNFCCC,COP		
Unit-II	**ENERGY AUDITING**	**(9)**
Needandtypesofenergyaudit.Energymanagement(audit)approach-understandingenergy costs, benchmarking,energyperformance,matching energyusetorequirement,maximizing systemefficiencies,optimizingtheinputenergy requirements,fuel&energy substitution,energy auditinstruments		
Unit-III	**ENERGY EFFICIENCY IN THERMAL UTILITIES**	**(9)**
Energyconservationavenuesinsteamgenerationandutilisation, furnaces, ThermicFluidHeaters. InsulationandRefractories-Commercialwasteheatrecovery devices:recuperator, regenerator, heatpipe, heat exchangers (Plate, Shell &Tube),heatpumps,andthermo compression		
Unit-IV	**ENERGY CONSERVTION IN ELECTRICAL UTILITIES**	**(9)**
Demandsidemanagement-Power factorimprovement–Energy efficienttransformers-Energy conservationavenuesinMotors,HVAC, fans, blowers,pumps,aircompressors,illumination systemsandcoolingtowers		
Unit-V	**SUSTAINABLE DEVELOPMENT**	**(9)**
SustainableDevelopment:Conceptsand Stakeholders,SustainableDevelopmentGoal(SDG). GlobalizationandEconomic growth.Economic development:Economicinequalities, Incomeand growth.Social development: Poverty,conceptualissuesandmeasures, impactofpoverty,		
Total No of Periods to be Taught	**45 periods**	

REFERENCES:

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1	Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp,awebsiteadministeredby BureauofEnergy Efficiency(BEE),a statutorybodyunder MinistryofPower,Governmentof India.2004
2	Eastop.T.D&Croft D.R, "EnergyEfficiencyfor EngineersandTechnologists",LogmanScientific&Technical, ISBN-0-582-03184,1990
3	W.R. Murphyand G.McKay"EnergyManagement" Butterworths, London1987
4	PratapBhattacharyya, "Climate Change and Greenhouse Gas Emission", New India PublishingAgency-Nipa,2020
5	MatthewJohnFranchetti,DefneApul"Carbon FootprintAnalysis:Concepts,Methods, Implementation,andCase Studies"CRC Press,2012
6	RobertA.Ristinen,JackJ.Kraushaar,JeffreyT.Brack,"EnergyandtheEnvironment",4th Edition,Wiley,2022

COURSE OUTCOMES: On completion of the course, the students will be able to	
CO1:	Understandtheprevailingenergyscenario
CO2:	Familiarise onenergyauditsanditsrelevance
CO3:	Applytheconcept ofenergyauditonthermalutilities
CO4:	Employrelevanttechniquesforenergy improvementin electrical utilities
CO5:	Understand Sustainable developmentand its impactonhumanresource development

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