Kongunadu College of Engineering and Technology

(Autonomous)
Affiliated to Anna University, Chennai
B.E. Biomedical Engineering
Regulations: R2024
Choice Based Credit System
I – VIII Semester
(Applicable for the Students Admitted from 2024 – 2025 onwards)

SEMESTER- I

S.No	Course Code	Course Title	Category	No. of Hours / Week			Credit
				L	T	P	
1.	24MC001	Induction Programme	MC	-	-	-	0
THEORY							
2.	24EN101	Communicative English	HSMC	3	0	0	3
3.	24MA101	Matrices and Calculus	BSC	3	1	0	4
4.	24PH101	Engineering Physics	BSC	3	0	2	4
5.	24CY101	Engineering Chemistry	BSC	3	0	2	4
6.	24GE102	Engineering Graphics	ESC	3	0	2	4
7.	24TA101	தமிழர் மரபு/Heritage of Tamils	HSMC	1	0	0	1
PRACTICALS							
8.	24GE104L	Engineering Practices Laboratory	ESC	0	0	4	2
9.	24EEC101L	Interpersonal Communication Laboratory	EEC	0	0	2	1
			TOTAL	**16**	**1**	**12**	**23**

SEMESTER-II

S.No	Course Code	Course Title	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24EN201	Technical English	HSMC	3	0	0	3
2.	24MA202	Vector Calculus and Numerical Analysis	BSC	3	1	0	4
3.	24MC002	Universal Human Values – 2 Understanding Harmony	HSMC	3	0	0	3
4.	24CY201	Environmental Sciences	BSC	3	0	0	3
5.	24GE101	Computer Fundamentals and C Programming	ESC	3	0	0	3
6.	24BM201	Biosciences for Biomedical Engineering	PCC	3	0	0	3
7.	24TA201	தமிழரும் ததொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1
PRACTICALS							
8.	24GE103L	C Programming Laboratory	ESC	0	0	3	1.5
9.	24BM202L	Biosciences Laboratory	PCC	0	0	3	1.5
10.	24EEC201L	Professional Communication Laboratory	EEC	0	0	2	1
			TOTAL	**19**	**1**	**8**	**24**

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SEMESTER-III

S.No	Course Code	Course Title	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24MA303	Transforms and Partial Differential Equations	BSC	3	1	0	4
2.	24BM301	Human Anatomy and Physiology	PCC	3	0	0	3
3.	24BM302	Medical Physics	PCC	3	0	0	3
4.	24EC201	Electric Circuits and Electron Devices	ESC	3	0	0	3
5.	24BM303	Electrical Engineering for Biomedical	PCC	3	0	0	3
6.	24AD201	Python Programming	ESC	3	0	0	3
PRACTICALS							
7.	24BM304L	Human Physiology Laboratory	PCC	0	0	2	1
8.	24EC202L	Circuits and Devices Laboratory	ESC	0	0	3	1.5
9.	24AD202L	Python Programming Laboratory	ESC	0	0	3	1.5
10.	24EEC301L	Soft Skills Development	EEC	0	0	2	1
			TOTAL	**18**	**1**	**10**	**24**

SEMESTER-IV

S.No	Course Code	Course Title	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24MA403	Probability and Statistics	BSC	3	1	0	4
2.	24BM401	Biomedical Instrumentation	PCC	3	0	0	3
3.	24BM402	Sensors and Measurements	PCC	3	0	2	4
4.	24BM403	Biocontrol Systems	PCC	3	0	0	3
5.	24EC406	Analog and Digital Integrated Circuits	PCC	3	0	0	3
6.	24MC003	Constitution of India	MC	2	0	0	0
PRACTICALS							
7.	24BM405L	Biomedical Instrumentation Laboratory	PCC	0	0	2	1
8.	24EC407L	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	2	1
9.	24EEC401L	Life Skills and Personality Development	EEC	0	0	2	1
			TOTAL	**17**	**1**	**8**	**20**

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SEMESTER-V

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24BM501	Diagnostic and Therapeutic Equipment	PCC	3	0	0	3
2.	24BM502	Biomaterials	PCC	3	0	0	3
3.	24BM503	Bio-Signal Processing	PCC	3	0	2	4
4.	24BM504	Radiological Equipments	PCC	3	0	0	3
5.		Professional Elective I	PEC	3	0	0	3
6.		Open Elective I	OEC	3	0	0	3
PRACTICALS							
7.	24BM505L	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	2	1
8.	24BM506L	Mini Project I	EEC	0	0	2	1
9.	24EEC501L	Professional Skills and Carrer Development	EEC	0	0	2	1
			TOTAL	**18**	**0**	**8**	**22**

SEMESTER-VI

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24BM601	Medical Image Processing	PCC	3	0	0	3
2.	24EC401	Microprocessors and Microcontrollers	PCC	3	0	0	3
3.		Professional Elective II	PEC	3	0	0	3
4.		Professional Elective III	PEC	3	0	0	3
5.		Open Elective II	OEC	3	0	0	3
PRACTICALS							
6.	24EC404L	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	1.5
7.	24BM602L	Medical Image Processing Laboratory	PCC	0	0	3	1.5
7.	24BM603L	Mini Project II	EEC	0	0	2	1
8.	24EEC601L	Employability Skills	EEC	0	0	2	1
			TOTAL	**15**	**0**	**10**	**20**

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SEMESTER-VII

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24BM701	Biomechanics	PCC	3	0	0	3
2.	24BM702	Embedded Systems and IoMT	PCC	3	0	0	3
3.	24BM703	Hospital Management	PCC	3	0	0	3
4.		Professional Elective IV	PEC	3	0	0	3
5.		Professional Elective V	PEC	3	0	0	3
PRACTICALS							
6.	24BM704L	Hospital Training	EEC	0	0	2	1
7.	24BM705L	Embedded Systems and IoMT Laboratory	PCC	0	0	2	1
			TOTAL	**15**	**0**	**4**	**17**

SEMESTER-VIII

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.		Professional Elective VI	PEC	3	0	0	3
2.		Professional Elective VII	PEC	3	0	0	3
PRACTICALS							
3.	24BM801L	Project Work	EEC	0	0	20	10
			TOTAL	**6**	**0**	**20**	**16**

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

S. No	Vertical 1 Bio Engineering	Vertical 2 Medical Device Innovation and Development	Vertical 3 Healthcare Management	Vertical 4 Mechanics in Healthcare	Vertical 5 Signal and Image Processing	Vertical 6 Wearable Communication	Vertical 7 Advanced Healthcare Devices
1.	24BM101PE Genetic Engineering	24BM201PE Foundation Skills in Integrated Product Development	24BM301PE Hospital Management	24BM401PE Biofluids and Dynamics	24BM501PE Artificial Organs and Implants	24BM601PE Virtual Reality and Augmented Reality	24BM701PE Human Assist Devices
2.	24BM102PE Biometric Systems	24BM202PE Healthcare Product Development	24BM302PE Medical Safety and Quality Assurance	24BM402PE Bio-Ergonomics	24BM502PE Telemedicine	24BM602PE Wearable Systems	24BM702PE Robotics in Medicine
3.	24BM103PE Neural Engineering	24ME305PE Rapid Manufacturing	24BM303PE Bio Statistics	24BM403PE Physiological Modeling	24BM503PE Pattern Recognition and Expert Systems in Medicine	24BM603PE Medical Informatics	24BM703PE Bio Nano Technology
4.	24BM104PE Biophotonics	24BM204PE Medical Device Quality Management System	24BM304PE Economics and Management for Engineers	24BM404PE Modeling and Designing of Bone and Dental Implants	24BM504PE Virtual Bioinstrumentation	24BM604PE Telehealth Technology	24BM704PE Biomedical LASER Instruments
5.	24BM105PE Medical Optics	24BM205PE Medical Innovation and Entrepreneurship	24BM305PE Forensic Science in Healthcare	24BM405PE Rehabilitation Engineering	24BM505PE Brain Computer Interface and its Applications	24BM605PE Body Area Networks	24BM705PE Critical Care Equipment
6.	24BM106PE Principles of Tissue Engineering	24BM206PE Machine Learning Techniques in Medicine	24BM306PE Clinical Engineering	24BM406PE Assistive Technology	24BM506PE Speech and Audio Signal Processing	24BM606PE Communication Systems	24BM706PE BioMEMS
7.	24BM107PE Physiology for Engineers	24BM207PE Embedded Medical Product Design	24BM307PE Enterprise Management	24BM407PE Physiological Control Systems	24BM507PE Deep Learning and Deployment of AI Models	24BM607PE Bio-Transport Processes	24BM707PE Advanced Diagnostic and Therapeutic Equipments
8	24BM108PE Bioinformatics: Algorithms and Applications	24BM208PE Microelectronics: Devices to Circuits	24BM308PE Organizational Behaviour	24BM408PE Introduction to Robotics	24BM508PE Exercise and Sports Biomechanics	24BM608PE Sensors and Actuators	24EC108PE Enclosure Design of Electronics Equipment

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: BIO ENGINEERING

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM101PE	Genetic Engineering	PEC	3	0	0	3
2	24BM102PE	Biometric Systems	PEC	3	0	0	3
3	24BM103PE	Neural Engineering	PEC	3	0	0	3
4	24BM104PE	Biophotonics	PEC	3	0	0	3
5	24BM105PE	Medical Optics	PEC	3	0	0	3
6	24BM106PE	Principles of Tissue Engineering	PEC	3	0	0	3
7	24BM107PE	Physiology for Engineers	PEC	3	0	0	3
8	24BM108PE	Bioinformatics: Algorithms and Applications	PEC	3	0	0	3

VERTICAL 2: MEDICAL DEVICE INNOVATION AND DEVELOPMENT

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM201PE	Foundation Skills in Integrated Product Development	PEC	3	0	0	3
2	24BM202PE	Healthcare Product Development	PEC	3	0	0	3
3	24ME305PE	Rapid Manufacturing	PEC	3	0	0	3
4	24BM204PE	Medical Device Quality Management System	PEC	3	0	0	3
5	24BM205PE	Medical Innovation and Entrepreneurship	PEC	3	0	0	3
6	24BM206PE	Machine Learning Techniques in Medicine	PEC	3	0	0	3
7	24BM207PE	Embedded Medical Product Design	PEC	3	0	0	3
8	24BM208PE	Microelectronics: Devices to Circuits	PEC	3	0	0	3

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VERTICAL 3: HEALTHCARE MANAGEMENT

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM301PE	Hospital Management	PEC	3	0	0	3
2	24BM302PE	Medical Safety and Quality Assurance	PEC	3	0	0	3
3	24BM303PE	Bio Statistics	PEC	3	0	0	3
4	24BM304PE	Economics and Management for Engineers	PEC	3	0	0	3
5	24BM305PE	Forensic Science in Healthcare	PEC	3	0	0	3
6	24BM306PE	Clinical Engineering	PEC	3	0	0	3
7	24BM307PE	Enterprise Management	PEC	3	0	0	3
8	24BM308PE	Organizational Behaviour	PEC	3	0	0	3

VERTICAL 4: MECHANICS IN HEALTHCARE

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM401PE	Biofluids and Dynamics	PEC	3	0	0	3
2	24BM402PE	Bio-Ergonomics	PEC	3	0	0	3
3	24BM403PE	Physiological Modeling	PEC	3	0	0	3
4	24BM404PE	Modeling and Designing of Bone and Dental Implants	PEC	3	0	0	3
5	24BM405PE	Rehabilitation Engineering	PEC	3	0	0	3
6	24BM406PE	Assistive Technology	PEC	3	0	0	3
7	24BM407PE	Physiological Control Systems	PEC	3	0	0	3
8	24BM408PE	Introduction to Robotics	PEC	3	0	0	3

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VERTICAL 5: SIGNAL AND IMAGE PROCESSING

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM501PE	Artificial Organs and Implants	PEC	3	0	0	3
2	24BM502PE	Telemedicine	PEC	3	0	0	3
3	24BM503PE	Pattern Recognition and Expert Systems in Medicine	PEC	3	0	0	3
4	24BM504PE	Virtual Bioinstrumentation	PEC	3	0	0	3
5	24BM505PE	Brain Computer Interface and Its Applications	PEC	3	0	0	3
6	24BM506PE	Speech and Audio Signal Processing	PEC	3	0	0	3
7	24BM507PE	Deep Learning and Deployment of AI Models	PEC	3	0	0	3
8	24BM508PE	Exercise and Sports Biomechanics	PEC	3	0	0	3

VERTICAL 6: WEARABLE COMMUNICATION

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM601PE	Virtual Reality and Augmented Reality In Healthcare	PEC	3	0	0	3
2	24BM602PE	Wearable Systems	PEC	3	0	0	3
3	24BM603PE	Medical Informatics	PEC	3	0	0	3
4	24BM604PE	Telehealth Technology	PEC	3	0	0	3
5	24BM605PE	Body Area Networks	PEC	3	0	0	3
6	24BM606PE	Communication Systems	PEC	3	0	0	3
7	24BM607PE	Bio-Transport Processes	PEC	3	0	0	3
8	24BM608PE	Sensors and Actuators	PEC	3	0	0	3

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VERTICAL 7: ADVANCED HEALTHCARE DEVICES

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM701PE	Human Assist Devices	PEC	3	0	0	3
2	24BM702PE	Robotics in Medicine	PEC	3	0	0	3
3	24BM703PE	Bio Nano Technology	PEC	3	0	0	3
4	24BM704PE	Biomedical LASER Instruments	PEC	3	0	0	3
5	24BM705PE	Critical Care Equipment	PEC	3	0	0	3
6	24BM706PE	BioMEMS	PEC	3	0	0	3
7	24BM707PE	Advanced Diagnostic and Therapeutic Equipments	PEC	3	0	0	3
8	24BM708PE	Enclosure Design of Electronic Equipments	PEC	3	0	0	3

Open Electives

(Students shall choose the Open Elective Courses, such that the course contents are not similar to any other contents/title under other course categories)

Open Elective I & II (Semester- V)

S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	24BM501OE	Medical Instruments	OEC	3	0	0	3
2	24BM502OE	Food, Nutrition and Health	OEC	3	0	0	3
3	24BM601OE	Traditional Indian Foods	OEC	3	0	0	3
4	24BM602OE	Fundamentals of Cell and Molecular Biology	OEC	3	0	0	3

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SUMMARY

S.No	Course Category	Credits As Per Semester								Total Credit	Percentage (%)	As Per AICTE
		I	II	III	IV	V	VI	VII	VIII			
1	HSMC	4	7	-	-	-	-	3	-	**14**	8.48	12
2	BSC	12	7	4	4	-	-	-	-	**27**	16.36	25
3	ESC	6	4.5	9	-	-	-	-	-	**19.5**	11.81	24
4	PCC	-	4.5	10	15	14	8	7	-	**58.5**	35.45	48
5	PEC	-	-	-	-	3	6	6	6	**21**	12.73	18
6	OEC	-	-	-	-	3	3	-	-	**6**	3.64	18
7	EEC	1	1	1	1	2	2	1	10	**19**	11.53	15
8	MC	-	-	-	-	-	-	-	-	-	-	-
Total		**23**	**24**	**24**	**20**	**22**	**19**	**17**	**16**	**165**	**100**	

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Open Elective Course (OEC)
Open Elective I (Semester-V)

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24AD101OE	Introduction to Artificial Intelligence	OEC	3	0	0	3
2.	24AD102OE	Introduction to Data Science	OEC	3	0	0	3
3.	24AG101OE	Basics of Agriculture Engineering	OEC	3	0	0	3
4.	24AG102OE	Farm Machinery	OEC	3	0	0	3
5.	24CE101OE	Industrial Waste Management	OEC	3	0	0	3
6.	24CE102OE	Ecological Engineering	OEC	3	0	0	3
7.	24CS101OE	Python Programming for Data Science	OEC	3	0	0	3
8.	24CS102OE	Programming and Data Structures	OEC	3	0	0	3
9.	24EC101OE	Principles of Signal Processing	OEC	3	0	0	3
10.	24EC102OE	Consumer Electronics	OEC	3	0	0	3
11.	24EE101OE	Power Generation Systems	OEC	3	0	0	3
12.	24EE102OE	Electrical Wiring and Lighting	OEC	3	0	0	3
13.	24ME101OE	Production Technology	OEC	3	0	0	3
14.	24ME102OE	Alternative Energy Fuels	OEC	3	0	0	3
15.	24IT101OE	Fundamentals of Software Engineering	OEC	3	0	0	3
16.	24IT102OE	Wireless Sensor Networks	OEC	3	0	0	3

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Open Elective Course (OEC)
Open Elective II (Semester-VI)

S.No	Course Code	Course Name	Category	No. of Hours/ Week			Credit
				L	T	P	
THEORY							
1.	24AD201OE	Basics of Visualization Toools	OEC	3	0	0	3
2.	24AD202OE	Foundations of Machine Learning	OEC	3	0	0	3
3.	24AG201OE	Introduction of Organic Farming	OEC	3	0	0	3
4.	24AG202OE	Introduction to Green House Technology	OEC	3	0	0	3
5.	24CE201OE	Global Warming and Climate Change	OEC	3	0	0	3
6.	24CE202OE	Building Services	OEC	3	0	0	3
7.	24CS201OE	Fundamentals of Operating Systems	OEC	3	0	0	3
8.	24CS202OE	Introduction to Database	OEC	3	0	0	3
9.	24EC201OE	Basics of Virtual Instrumentation	OEC	3	0	0	3
10.	24EC202OE	Telecommunications for Society	OEC	3	0	0	3
11.	24EE201OE	Energy Audit and Management	OEC	3	0	0	3
12.	24EE202OE	Electric Vehicles	OEC	3	0	0	3
13.	24ME201OE	Basics of Automotive Components	OEC	3	0	0	3
14.	24ME202OE	Unconventional Machining Processes	OEC	3	0	0	3
15.	24IT201OE	Introduction to WEB Development	OEC	3	0	0	3
16.	24IT202OE	Principles of Multimedia	OEC	3	0	0	3

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Annexure-IV
Vertical for Minor Degree
(In addition to all the verticals of other programmes)

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

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24MC001	INDUCTION PROGRAMME	L T P C - - - 0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. " Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

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(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities
About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science. Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References: Guide to Induction program from AICTE

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24EN101	COMMUNICATIVE ENGLISH (Common to All Branches)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Develop basic communication skills in English.
- Enhance the speaking skills for academic, professional and social purposes.
- Use of the electronic media such as internet and other online resources for their language development.
- Inculcate the habit of reading and writing for the purpose of effective communication
- Develop confidence in learners to communicate in English for all purposes

UNIT I BASICS OF COMMUNICATION 9

Listening: Basics of listening-Intensive and Extensive Listening, Barriers to Effective Listening; Speaking: Speaking about Future plans- Giving instruction to use the product, Reading: Skimming and Scanning, Writing: Writing about one's leisure time activities, hometown, everyday activities etc., Grammar: Parts of speech, Prepositions, Vocabulary: Word formation.

UNIT II CREATIVE COMMUNICATION 9

Listening: Listening to short lectures /talks, Speaking: Telephonic interview, Reading: Reading Editorial and Opinion Blogs, Writing: Biographical writing - Writing a paragraph (Cause and Effect/Compare and Contrast/Narrative/Analytical) - Grammar: Gerund and Infinitive - Present Tense, Vocabulary: Abbreviations & Acronyms.

UNIT III FUNCTIONAL COMMUNICATION 9

Listening: Listening to radio and TV and taking notes - Focused audio tracks, Speaking: Role Play - Group Interaction, Reading: Reading magazines, Writing: Letter (Informal /Formal – Industrial Visit, Internship, etc),Writing a set of instructions, Grammar: Past Tense -Subject - Verb Agreement, Vocabulary: Question Tags.

UNIT IV ANALYTICAL SKILLS 9

Listening: Listening to select talks by eminent personalities, speaking: Speaking in mock Interviews, Reading: Reading advertisements, Writing: Writing a set of recommendations, Interpreting Visual Materials (Line Graphs, Pie Charts etc.), Grammar: Sentence Pattern, Future Tense, Articles, Vocabulary: Single word substitutes.

UNIT V PROFESSIONAL COMMUNICATION 9

Listening: Understanding different Accents,Listening to TED talks, Speaking: Giving impromptu talks- Making presentations, Reading: Reading and comprehending a passage, Writing: Letter to the editor- Check list, Grammar: Direct and Indirect Speech, Vocabulary: Phrasal Verbs.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Use suitable vocabulary with confidence and express their ideas both in speech and writing.
- Write intelligibly avoiding grammatical errors, using a range of vocabulary, organizing their ideas logically on a topic.
- Speak confidently, with one or many listeners using appropriate communicative strategies.
- Read different genres of texts adopting various reading strategies.
- Understand different spoken discourses/excerpts in different accents.

TEXT BOOKS:

1. Kumar, Sanjay and Lata, Pushp, "Communication Skills", Oxford University Press. 2018.

REFERENCES:

1. DuttP. Kiranmai and Rajeevan Geeta, "Basic Communication Skills", Foundation Books, 2007.
2. Mohan, Krishna and Banerji Meera, "Developing Communication Skills", Macmillan Publishers India Ltd., Delhi: 2009.
3. Martin Hewings "Advanced English Grammar: A self study reference and Practice book for advanced South Asian students" Cambridge University Press, Delhi: 2016.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	2	-	-	2	-	1	2	3	-	2
CO2	-	-	2	-	2	-	-	2	3	1	-
CO3	-	-	2	-	2	1	2	3	3	2	2
CO4	-	-	-	2	2	1	2	3	3	2	2
CO5	2	3	-	2	3	-	2	-	3	1	2

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24MA101	MATRICES AND CALCULUS (Common to All Branches)	L T P C 3 1 0 4

OBJECTIVES:

The students should be made to:

- Introduce the matrix techniques and to illustrate the nature of the matrix.
- Remember the basic concepts of solving algebraic and transcendental equations.
- Apply the formula for the curvature of a curve defined in Cartesian coordinates.
- Analyze the Partial differentiation, concept of total derivative, finding maxima and minima of function of two variables.
- Evaluate the techniques of integration in finding area and volume.

UNIT I MATRICES **9+3**

Eigenvalues and eigenvectors of a real matrix - Properties of eigenvalues and eigenvectors - Cayley-Hamilton theorem (Without proof) - Application of Cayley - Hamilton theorem (A^{-1},A^n)- Nature of quadratic forms - Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II SYSTEM OF LINEAR EQUATIONS **9+3**

Newton Raphson method- Bisection Method -Solution of linear system of equations by matrix method, Gauss-Jordan, Gauss- Jacobi and Gauss-Seidel methods- Eigen values of a matrix by Power method.

UNIT III DIFFERENTIAL CALCULUS **9+3**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normal.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial derivatives - Total derivative - Differentiation of implicit functions - Jacobians - Taylor's series for functions of two variables - Maxima and minima of functions of two variables.

UNIT-V MULTIPLE INTEGRALS IN CARTESIAN COORDINATES **9+3**

Double integration- Change of order of integration- Area between two curves- Triple integration- Volume as triple integrals.

TOTAL: (45+15) PERIODS

OUTCOMES:

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

- Develop problem-solving skills using systems of equations and matrix transformations.
- Evaluate the efficiency of numerical methods based on the number of iterations required to achieve a desired level of accuracy.
- Compute the radius of curvature and interpret its significance for different types of curves.
- Expand a given function into a series and determine the maximum and minimum of multivariate functions.
- Apply the concepts of double and triple integrals in mathematical and real-world contexts.

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TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2018.

REFERENCES:

1. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2018.
2. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 4th Edition, New Delhi, 2021.
3. Ramana B V "Higher Engineering Mathematics", New Delhi Tata McGraw- Hill Education India Private Limited., 2021
4. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" 7th Edition, Pearson Education India, 2017.

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	-	-	-	-	-	2
CO2	3	3	2	3	2	-	-	-	-	-	2
CO3	3	3	2	2	2	1	-	-	-	-	2
CO4	3	3	2	3	3	1	-	-	-	-	2
CO5	3	2	3	3	3	2	-	-	-	-	3

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24PH101	ENGINEERING PHYSICS (Common to All Branches)	L T P C 3 0 2 4

OBJECTIVES:

The students should be made to:

- Recall the mechanical properties of materials.
- Gain knowledge on electrical properties of materials.
- Understand the properties of magnetic and superconducting materials.
- Examine basic quantum mechanical concepts and their applications.
- Acquire the basic knowledge about nano phase materials and their properties.

UNIT I MECHANICAL PROPERTIES OF SOLIDS 9

Elasticity and Plasticity - stress-strain diagram and its uses - Hooke's law - factors affecting elastic modulus - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment – I shaped girders and its applications.

UNIT II ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory of metals - Electrical conductivity and thermal conductivity of metals - Wiedemann - Franz law - Failures of classical free electron theory - Success of Quantum free electron theory - Fermi distribution function and its variation with temperature - Density of energy states-carrier concentration of metals.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Classification of magnetic materials - Domain theory of ferromagnetism - Hysteresis - Soft and Hard magnetic materials - Superconducting materials – Meissner effect - Isotopic effect - BCS theory of superconductors - Type I & Type II superconductors - Applications of superconductors.

UNIT IV QUANTUM PHYSICS 9

Black body radiation - Planck's theory (derivation) - Deduction of Wien's displacement law and Rayleigh Jeans' Law from Planck's theory-de-Broglie wavelength - Properties of matter waves - Schrodinger's wave equations - Time independent and time dependent wave equations - Physical significance of wave function - Particle in a one dimensional potential box.

UNIT V NEW ENGINEERING MATERIALS 9

Metallic glasses - Types - Preparation - Properties and applications - Shape Memory Alloys (SMA) - Characteristics and applications - Advantages and disadvantages of shape memory alloys - Synthesis of nanomaterials - Top down approaches (Ball Milling) and Bottom up approaches (CVD and PVD).

TOTAL: 45 PERIODS

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LIST OF THE EXPERIMENTS – PHYSICS LABORATORY

1. Determination of Young's modulus of the material by Non-uniform bending method.
2. Determination of Rigidity modulus of the wire using Torsion Pendulum.
3. Determination of band gap energy of a semiconductor.
4. Determination of thickness of the thin film/wire by forming the fringe using Air wedge method.
5. Determination of velocity of ultrasonic waves in a liquid and compressibility of liquid using ultrasonic Interferometer.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Identify the mechanical properties of materials and their significance in engineering applications.
- Interpret the electrical properties of materials and their role in various technological applications.
- Illustrate the magnetic and superconducting properties of materials and their practical implications.
- Apply fundamental quantum mechanical concepts to understand material behavior at the atomic level.
- Explore the properties and applications of smart materials in modern engineering solutions.

TEXT BOOKS:

1. M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy "A Text book of Engineering Physics", S.Chand and Company Ltd, New Delhi, 11th Edition.2022.
2. Rajendran. V. "Materials Science", McGraw Hill Education (India) Private Limited, New Delhi, 2017.
3. S.O Pillai, "Solid State Physics" New Age International Publishers, New Delhi, 10th Edition, 2022.

REFERENCES:

1. R. K. Gaur and S.L. Gupta, "Engineering Physics", Dhanpat Rai Publications, New Delhi, Reprint 2022.
2. Wahab. M.A, "Solid State Physics' Narosa Publishing House, New Delhi, 4th Edition. 2023.
3. D. Halliday, R. Resnick and J. Walker, Principles of Physics, Wiley (11th Edition), 2020.
4. Malik.K and Singh. A.K, "Engineering Physics" TMH, New Delhi 2nd Edition - 2020.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

PHYSICS LABORATORY

S.No.	Name of Equipment	Quantity Required
1	Torsional pendulum with accessories	6 Nos.
2	Non - Uniform bending with accessories	6 Nos.
3	Ultrasonic interferometer.	6 Nos.
4	Air wedge with accessories	6 Nos.
5	Band gap kit	6 Nos.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	1	1	-	-	-	-	-	1
CO2	3	2	2	3	2	-	-	-	-	-	2
CO3	3	3	2	3	2	1	-	-	-	-	-
CO4	3	2	2	3	3	-	-	-	-	-	2
CO5	2	2	2	2	2	2	-	-	-	-	3

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24CY101	ENGINEERING CHEMISTRY (Common to All Branches)	L T P C 3 0 2 4

OBJECTIVES:

The student should be made to:

- Gain knowledge on various sources of water and its industrial applications.
- Explore the essentials of electrochemistry, types of corrosion and its prevention.
- Examine the fundamentals of polymer, various engineering plastics and composites.
- Study the concept of Phase diagrams, different types of energy storage devices and emerging batteries.
- Assess the types of fuels and its quality estimation.

UNIT I WATER TECHNOLOGY **9**

Sources of water - Hard and soft water - Boiler feed water-requirements - disadvantages of using hard water in boilers (Scale, Sludge, Caustic Embrittlement, Priming and Foaming) - Municipal water treatment (screening, sedimentation, coagulation, filtration and disinfection - ozonolysis, UV treatment, chlorination). Internal conditioning (Phosphate, Calgon, Colloidal and Carbonate conditioning methods) - External conditioning - Zeolite and demineralization process - desalination by reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION SCIENCE **9**

Electrochemistry - Nernst equation & its Applications - Electrochemical (EMF) series - Corrosion - Types - Chemical and Electrochemical corrosions - Galvanic corrosion - Differential aeration corrosion - Pitting corrosion - Corrosion control - material selection and design - sacrificial anodic method and impressed current cathodic protection method - Organic coatings - Paint and its constituents.

UNIT III POLYMERS AND COMPOSITES **9**

Introduction: Functionality - degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces) - Mechanism of free radical polymerization - Engineering Plastics: Polyamides, Polycarbonates and Polyurethanes.

Composites: Need, Composition of composites - Definition, examples and applications of Metal matrix composites (MMC), Ceramic matrix composites (CMC) and Polymer matrix composites (PMC)

UNIT IV PHASE RULE AND ENERGY STORAGE DEVICES **9**

Phase Rule - Terms involved - One Component system (water system) - Two component system (Lead-Silver system) - Storage devices - types - primary battery (dry cell), secondary battery (lead acid, lithium-ion battery) - Emerging batteries - Aluminum air battery, batteries for automobiles and satellites - Fuel cells - Hydrogen - Oxygen fuel cell.

UNIT V FUELS AND COMBUSTION **9**

Fuels – Introduction - Classification of fuels - coal - Analysis of coal (proximate and ultimate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - Manufacture of synthetic petrol (Bergius process) - Knocking - Anti knocking - Octane number - Cetane number - Gaseous fuels - LPG, CNG - Combustion: Calorific value - higher and lower calorific values - Theoretical calculation of calorific value - Flue gas analysis (ORSAT Method).

TOTAL: 45 PERIODS

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LIST OF THE EXPERIMENTS - CHEMISTRY LABORATORY

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of Chloride content of water sample by Argentometric method.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Estimation of Copper content by spectrophotometer.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid Vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Understand the various water treatment methodologies and its applications.
- Recognize corrosion protection techniques and appropriate mitigation strategies.
- Assess different types of polymers, composites and their industrial applications.
- Illustrate the concept of phase diagram, working principles of batteries, emerging energy storage technologies and their applications.
- Analyze the various fuels and their properties.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing, Company, New Delhi, 2015.
2. S. S. Dara, "A Text Book of Engineering Chemistry", S Chand & Co. Ltd., New Delhi, 2013.

REFERENCES:

1. Shika Agarwal, "Engineering Chemistry", Cambridge University Press, Delhi, 2016.
2. B. Sivashankar, "Engineering Chemistry", Tata Mc. Graw–Hill Publishing Company, Ltd., Delhi, 2012.
3. G Palanna, "Engineering Chemistry", Tata Mc. Graw Hill Education Private Limited, Delhi, 2017.
4. Prasanta Rath,"Engineering Chemistry", Cengage Learning India Pvt. Ltd., Delhi, 2018.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CHEMISTRY LABORATORY

S.No.	Name of Equipment	Quantity Required
1	pH Meter	10 Nos.
2	Digital Conductivity Meter	10 Nos.
3	Digital Potentiometer	10 Nos.
4	Electronic Balance	5 Nos.
5	Deionizer unit	1 No.
6	Spectrophotometer	5 Nos.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	2	3	2	-	-	-	-
CO2	3	2	-	-	2	3	2	-	-	-	-
CO3	3	-	2	2	3	2	-	-	-	-	-
CO4	3	2	1	-	3	2	-	-	-	-	2
CO5	3	3	1	-	2	3	2	-	-	-	2

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24GE102	ENGINEERING GRAPHICS (Common to All Branches)	L T P C 3 0 2 4

OBJECTIVES:

The student should be made to:

- Understand the various basic concepts like dimensioning, standards, curves and free hand sketching
- Develop the skills on projection of points, lines and plane surfaces
- Impart knowledge on projection of solids like prisms and pyramids
- Illustrate the section of solids and development of surfaces for various objects
- Acquire skills on viewing of solid objects in Isometric and Perspective projections

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) **2**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and geometric dimensioning

UNIT I PLANE CURVES AND FREE HAND SKETCHING **9+6**

Curves used in engineering practices: Conics - Construction of ellipse, Parabola and hyperbola by eccentricity method - Construction of cycloid and involutes of square and circle- Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views – Free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **9+6**

Projection of points - Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true length and true inclination by rotating line method - Projection of planes inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **7+6**

Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **9+6**

Sectioning of solids: prisms, pyramids, cylinder, cone 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, cylinder and cone.

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UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **9+6**

Principles of isometric projection - isometric scale - isometric projections of simple solids, truncated and frustum of solids: Prisms, pyramids, cylinder, cone - Perspective projection of simple solids: Prisms, pyramids and cylinder by visual ray method.

TOTAL: 75 (45+30) PERIODS

OUTCOMES:

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

- Relate the engineering knowledge on dimensioning, standards, curves and free hand sketching objects
- Identify the various views on the projection of points, straight lines and plane surfaces
- Apply the knowledge on projection of solids like prisms and pyramids
- Analyze the section of solids and development of surfaces
- Develop the isometric views and perspective projection of simple solids

TEXT BOOKS:

1. Natarajan K V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2023.
2. Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2024.

REFERENCES:

1. Bhatt N D and Panchal V M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2023.
2. Basant Agarwal and Agarwal C M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2019.
3. Gopalakrishna K R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore, 2017.

Special points applicable to End Semester Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use an appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	3	-	2
CO2	3	2	2	-	-	-	-	-	3	-	2
CO3	3	2	2	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	-	3	-	2
CO5	3	2	2	-	-	-	-	-	3	-	2

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24TA101	HERITAGE OF TAMILS (Common to All Branches)	L T P C 1 0 0 1

OBJECTIVES:

The students should be made to:

- Learn the extensive literature of classical Tamil.
- Analyze rock art paintings to modern art.
- Understand folk and martial arts.
- Apply the concepts of Thinai in Tamils.
- Realize the contribution of Tamils in Indian freedom struggle.

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages –Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II 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 III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V 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: 15 PERIODS

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OUTCOMES:

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

- Recognize the extensive literature Tamil and classical nature.
- Understand the heritage of sculpture, painting and musical instruments.
- Classify the folk and martial arts of Tamil people.
- Realization of Thinai concepts, trade and victory of Chozha dynasty.
- Interpret the contribution of Tamils in Indian freedom struggle, Self- esteem movement and siddha medicine.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatanianian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	1	2	-	1
CO2	-	-	-	-	-	-	2	1	2	-	1
CO3	-	-	-	-	-	-	2	1	2	-	1
CO4	-	-	-	-	-	-	2	1	2	-	1
CO5	-	-	-	-	-	-	2	1	2	-	1

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24TA101	தமிழர் மரபு (அனைத்து துறைகளுக்கும் பொதுவானது)	L T P C 1 0 0 1

நோக்கங்கள்:

மாணவர்கள் கண்டிப்பாக அறிய வேண்டுவன:

- செம்மொழியான தமிழ் மொழியின் விரிவான இலக்கியத்தைப் பற்றி அறிதல்.
- பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை உள்ள கலைகளை பகுப்பாய்வு செய்தல்.
- நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகளைப் புரிந்துகொள்ளுதல்.
- தமிழர்களின் திணைக் கோட்பாடுகளைச் செயல்படுத்துதல்.
- இந்திய விடுதலைப் போராட்டத்திற்கும் பண்பாட்டிற்கும் தமிழர்களின் பங்களிப்பை உணருதல்

அலகு 1 மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் -தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் -குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை , வீணை , யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள்

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போற்றிய அறக்கோட்பபாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –சங்ககால நகரங்களும் துறை முகங்களும் -சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

முடிவுகள்:

பாடத்தின் முடிவில், மாணவர்கள் அறிந்து கொள்வன:

- தமிழ் மொழியின் செம்மொழி தன்மையையும் சங்க இலக்கியத்தின் முக்கியத்துவத்தையும் உணர்வார்கள்.
- தமிழர்களின் சிற்ப, ஓவிய, இசை மரபுகளை புரிந்துகொள்வார்கள்.
- நாட்டுப்புறக் கலைகளையும் வீர விளையாட்டுகளையும் வகைப்படுத்துவார்கள்.
- தமிழர்களின் திணைக் கோட்பாடுகளும் சங்ககால வர்த்தகமும் புரிந்துகொள்வார்கள்.
- இந்திய விடுதலைப் போராட்டம், சுயமரியாதை இயக்கம், சித்த மருத்துவம் ஆகியவற்றில் தமிழர்களின் பங்களிப்பை விளக்குவார்கள்.

உரை மற்றும் குறிப்பு புத்தகங்கள்:

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)

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9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	1	2	-	1
CO2	-	-	-	-	-	-	2	1	2	-	1
CO3	-	-	-	-	-	-	2	1	2	-	1
CO4	-	-	-	-	-	-	2	1	2	-	1
CO5	-	-	-	-	-	-	2	1	2	-	1

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24GE104L	ENGINEERING PRACTICES LABORATORY (Common to All Branches)	L T P C 0 0 4 2

OBJECTIVES:

The student should be made to:

- Acquire knowledge in calculation of area and volume of various 2D and 3D shapes and gain practical exposure in pipeline connections and carpentry
- Develop the fundamental skills in welding, machining, sheet metal and foundry works
- Illustrate the basic working principles of air conditioner, industrial robot and washing machine
- Learn the domestic, industrial wiring circuits and measure the electrical parameters
- Demonstrate the basic electronic components in PCB, assemble of smart phone, computer and LED TV

GROUP A (CIVIL & MECHANICAL)

I. CIVIL ENGINEERING PRACTICES 15

Basic Measurements

1. Calculation of area and volume for various solid and hollow shapes, including cubical, spherical, cylindrical and conical models with different scale conversions.

Carpentry

2. Study of industrial trusses and joints in doors and windows using models.
3. Sawing and planing- Making joints: T-joint, Mortise joint, and Tenon joint.

Plumbing

4. Laying pipe connections for suction and delivery sides of the pumps and preparation of plumbing line sketches for water supply and sewage works.
5. Connecting various pipe fittings using different materials (metal, plastic, and flexible pipes) and other components which are commonly used in household appliances.

II. MECHANICAL ENGINEERING PRACTICES 15

Welding:

a) Arc Welding
   i) Butt joint
   ii) Lap joint
b) Gas welding practice

Basic Machining:

a) Turning and Facing
b) Drilling and tapping

Sheet Metal work:

a) Making of a funnel
b) Making of a tray

Foundry work:

a) Making a mould using solid pattern
b) Making a mould using split pattern

Study Experiments

a) Study of components in Air conditioner
b) Study of components in Industrial robot
c) Study of components in Washing machine

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GROUP B (ELECTRICAL AND ELECTRONICS)

III. ELECTRICAL ENGINEERING 15

1. Residential house wiring using switches, fuse, indicator, circuit breaker, lamp and Energy meter
2. Stair case wiring
3. Industrial wiring using switches, fuse, indicator and Energy meter
4. Measurement of electrical quantities - voltage, current, power, power factor and energy in RLC circuit
5. Calculation of energy consumption for different lamps
6. Study of fan with regulator, Iron Box and Emergency Lamp

IV. ELECTRONICS ENGINEERING 15

1. Study and identification of electronic components -Resistors, Capacitors and Inductors
2. Assembling and testing electronic components in small PCB
3. Assembling and dismantling of Computer/Laptop
4. Assembling and dismantling of LED TV
5. Study of elements in smart phone

TOTAL: 60 PERIODS

OUTCOMES:

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

- Interpret engineering knowledge on calculation of area and volume of different geometric shapes, connecting various household fittings and making carpentry joints
- Apply engineering skills to do welding, machining, sheet metal and foundry works
- Gain knowledge on Air conditioner, Industrial robot and washing machine
- Understand the domestic, industrial wiring circuits and measure the various electrical parameters
- Analyze the basic components of electronic circuits, computer, laptop, smart phone and LED TV

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	2	2	-	2	-	-	2
CO2	3	2	2	-	2	2	-	2	-	-	2
CO3	3	2	1	-	2	2	-	2	-	-	2
CO4	3	2	1	-	2	2	-	2	-	-	2
CO5	3	2	2	-	2	2	-	2	-	-	2

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24GE104L ENGINEERING PRACTICES LABORATORY

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

GROUP A (CIVIL & MECHANICAL)

S. No	Name of Equipment	Quantity Required
	CIVIL ENGINEERING PRACTICES	
Basic Measurements		
1.	Sphere	03 Nos.
2.	Cylinder	03 Nos.
3.	Cone	03 Nos.
4.	Cube	03 Nos.
5.	Cuboid	03 Nos.
Carpentry		
6.	Industrial truss	03 Nos.
7.	Door Joint	03 Nos.
8.	Window Joint	03 Nos.
9.	Try Square	15 Nos.
10.	Hand Saw	15 Nos.
11.	Carpentry bench vice	15 Nos.
12.	Firmer Chisel	15 Nos.
13.	Motrin Chisel	15 Nos.
14.	Iron Jack	15 Nos.
15.	Mallet	15 Nos.
16.	Bench hold fastens (C Clamp)	15 Nos.
17.	Wood Cutting Machine	2 Nos.
18.	Planer machine	2 Nos.
19.	Hand drilling Machine	2 Nos.
20.	Jig Saw	2 Nos.
Plumbing		
21.	Pipe Vice	15 Nos.
22.	Die Holder with Die set	10 Nos.

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S. No	Name of Equipment	Quantity Required
	MECHANICAL ENGINEERING PRACTICES	
Welding		
1.	Arc welding unit	5 Nos.
2.	Gas welding unit	2 Nos.
Basic Machining		
3.	Lathe Machines	3 Nos.
4.	Drilling Machines	2 Nos.
Sheet Metal work		
5.	Steel rule	5Nos.
6.	Bend snips	5 Nos.
7.	Straight snips	5 Nos.
8.	Scriber	5 Nos.
9.	Divider	5 Nos.
10.	Trammel	5 Nos.
11.	Prick Punches	5 Nos.
12.	Centre punches	5 Nos.
13.	Pliers	5 Nos.
14.	Ball peen hammer	5 Nos.
15.	Cross peen hammer	5 Nos.
16.	Bull wart hammer	5 Nos.
17.	Mallet	5 Nos.
18.	Anvil	3 Nos.
19.	Swage block	3 Nos.
20.	Wire gauges	2 Nos.
Foundry work		
21.	Cope and Drag Box	5 Nos.
22.	Solid pattern	5 Nos.
23.	Split pattern	5 Nos.
24.	Runner	5 Nos.
25.	Riser	5 Nos.
26.	Sprue pin	5 Nos.
27.	Sand rammer	5 Nos.
28.	Trowel	5 Nos.
Study Experiments		
29.	Air-conditioner unit	1 No.
30.	Industrial Robot	1 No.
31.	Washing Machine	1 No.

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24GE104L **ENGINEERING PRACTICES LABORATORY (GROUP – B)**

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Quantity Required (Nos)
Part III: Electrical Engineering		
1.	Single phase house wiring setup	5
2.	Three phase house wiring setup	3
3.	Staircase wiring setup	3
4.	Fluorescent lamp and LED with wiring setup	Each 3
5.	Emergency lamp wiring setup	2
6.	Iron box wiring setup	2
7.	Fan with Regulator	2
8.	AC Voltmeter, Ammeter, Wattmeter and Energy Meter	Each 4
9.	R-Load	4
10.	Inductive and Capacitive Load	Each 1
Part IV: Electronics Engineering		
1.	Soldering Iron, Lead	10 Set
2.	Multi meter	10
3.	Continuity tester	10
4.	Used Laptop	3
5.	Used desktop computer	3
6.	Used LED TV	3
7.	Used Smart Phone	3
8.	DC Regulated power supply (0-30V)	2
9.	Resistors	200
10.	Capacitors	200
11.	Diodes	100
12.	Transistors	50

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24EEC101L INTERPERSONAL COMMUNICATION LABORATORY L T P C
(Common to All Branches) 0 0 2 1

OBJECTIVES:
The students should be made to:

- Improve the communicative competence of learners
- Help learners use language effectively in academic/work contexts
- Develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- Build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- 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 (formal & informal); Telephone conversation; Speaking - 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 FUNCTIONAL COMMUNICATION 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 PROFESSIONAL SKILLS 6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic.

TOTAL: 30 PERIODS

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OUTCOMES:

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

- Listen to and comprehend general as well as complex academic information.
- Listen to and understand different points of view in a discussion.
- Speak fluently and accurately in formal and informal communicative contexts.
- Describe products and processes and explain their uses and purposes clearly and accurately.
- Express their opinions effectively in both formal and informal discussions.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	2	3	-	2
CO2	-	-	-	-	-	-	2	2	3	-	2
CO3	-	-	2	-	3	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2
CO5	-	-	-	-	-	3	2	2	3	-	-

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LIST OF EQUIPMENTS
Requirements for a batch of 30 students

Sl. No.	Description of Equipment/Software	Quantity required (Nos)
1	Computer	30
2	Headphones	30
3	**Software:** Globarena	30

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24EN201	TECHNICAL ENGLISH (Common to All Branches)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Improve understanding of commonly used English usage by cultivating listening skills through informal interactions.
- Enrich their speaking abilities through scenario-based conversations to understand how language functions in context.
- Develop their ability to read critically by analyzing newspaper articles.
- Use group discussion techniques to improve cooperative communication.
- Enhance your ability to write professionally by creating organized reports.

UNIT I CONVERSATION **9**

Listening: Listening to informal conversations, Speaking: Short conversations in varied situations in student life, Reading: Reading Short text and longer passages for comprehension at deeper levels, Writing: Writing reviews (book / film), Grammar: Compound Nouns - Numerical Expression, Vocabulary: Cause and Effect Expressions.

UNIT II LANGUAGE IN USE **9**

Listening: Listening to Situation based Dialogues, Speaking: Asking about Routine actions and giving directions, Reading: Reading a short story for appreciation and understanding, Writing: Writing Emails - Dialogue writing, Grammar: Purpose expressions - Adverbs, Vocabulary: Imperative sentences.

UNIT III ENGLISH FOR SPECIFIC PURPOSE **9**

Listening: Listening strategies for deeper understanding, Speaking: Using dictionary for learning pronunciation, stress and syllable divisions, Reading: an article from Newspaper - Critical reading, Writing: Note-Making / Note-Taking - Essay writing, Grammar: Definition, Degrees of Comparison, Vocabulary: Model verbs.

UNIT IV ENGLISH FOR CAREER **9**

Listening: Listening to the interviews of CEOs / entrepreneur, Speaking: Group Discussion skills, Reading: pre reading and post reading tasks, Writing - Job application - Cover letter & Resume, Grammar: Active and Passive voice, Relative Pronouns, Vocabulary: Synonyms and Antonyms.

UNIT V REPORT WRITING **9**

Listening: Listening and making notes, Speaking: Discussion on problems and solutions (case studies), Reading: Reading abstracts / Journal Articles, Writing: Minutes of meeting, Reports (Feasibility / Accident / Survey Report), Grammar: If Clause, Vocabulary: Idioms and their Meanings.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Respond to informal conversations with effectiveness, exhibiting understanding.
- Appreciate and critically engage with short stories, articulating insights.
- Utilize dictionaries to comprehend syllable structures and pronounce words correctly.
- Engage in healthy group discussions by answering peers' questions and sharing ideas.
- Acquire constructive criticism in case study by describing issues.

TEXT BOOKS:

1. Bhatnagar, Nitin and Bhatnagar, Mamta, "Communicative English for Engineering and Professionals", Pearson Education India, 2010.

REFERENCES:

1. Raman, Meenakshi and Sharma, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, Delhi, 2019.
2. Andrea J, Rutherford. "Basic Communication Skills for Technology", Pearson Education, Inc., 2013.
3. Rizvi M, Ashraf. "Effective Technical Communication", Tata McGraw Hill Education Pvt.Ltd., Delhi,2017.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	1	-	-	2	3	-	2
CO2	-	-	1	-	-	2	2	-	3	-	2
CO3	-	-	-	-	2	-	2	-	3	-	-
CO4	-	-	-	2	-	-	2	3	3	-	-
CO5	-	2	-	2	-	2	2	2	3	-	-

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24MA202	VECTOR CALCULUS AND NUMERICAL ANALYSIS (Common to BME, EEE and ECE)	L T P C 3 1 0 4

OBJECTIVES:

The Student should be made to:

- Grasp the fundamental ideas of vectors, vector fields, and scalar fields.
- Identify the field of engineering in ODE as an effective tool for resolving practical issues.
- Interpret the geometric implications of analytic functions in terms of conformal mapping.
- Differentiate the concepts of numerical differentiation and integration procedures, which have significant role in the field of engineering.
- Test the numerous approaches and strategies for resolving different kinds of ODEs.

UNIT I VECTOR CALCULUS **9+3**

Gradient of a Scalar point function – Divergence, Curl, Solenoidal and irrotational of a vector point function – Directional Derivative – Green's, Gauss divergence and Stoke's theorems (without proof)

UNIT II ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Higher order linear differential equations with constant coefficients ($e^{ax}V, x^nV$) – Method of variation of parameters – Cauchy's linear differential equations- Legendre's linear differential equations

UNIT III ANALYTIC FUNCTIONS **9+3**

Functions of a complex variable – Analytic functions: Necessary condition – Cauchy-Riemann equations and sufficient condition (excluding proofs) Harmonic and orthogonal properties of analytic function – Construction of analytic functions by Milne's method – Conformal mapping ($w = z + k, 1/z, kz$) – Bilinear transformation.

UNIT IV NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3**

Newton's forward and backward difference formulae – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by 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 – Fourth order Runge-Kutta method for solving first order equations – Multi step methods – Milne's predictor corrector methods for solving first order equations.

TOTAL: (45+15) PERIODS

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OUTCOMES:

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

- Understand the concepts of gradient, divergence, and curl in vector calculus.
- Interpret the suitable techniques for solving second and higher-order differential equations.
- Utilize conformal mapping and analytic functions to transform complex functions between different domains.
- Apply the different approaches and strategies for solving first- and second-order ordinary differential equations.
- Develop the multi-step methods for solving initial value problems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2018.

REFERENCES:

1. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2018.
2. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition New Delhi, 2013.
3. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pt.Ltd, 4th Edition, New Delhi, 2021.
4. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" 7th Edition, Pearson Education India, 2017.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	-	-	-	-	-	2
CO2	3	3	3	3	2	2	-	-	-	-	2
CO3	3	3	3	-	3	-	-	-	-	-	1
CO4	3	3	2	2	2	1	-	-	-	-	2
CO5	3	3	2	3	2	-	-	-	-	-	2

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BoS (S&H) 19/12/25

24MC002	UNIVERSAL HUMAN VALUES 2 - UNDERSTANDING HARMONY (Common to All Branches)	L T P C 2 1 0 3

OBJECTIVES:

The students should be made to:

- Demonstrate an understanding of ethical principles and human values
- Apply critical thinking to analyze ethical dilemmas and conflicts
- Communicate effectively about ethical issues and human values
- Appreciate the importance of harmony in personal, social, and environmental contexts
- Engage in practices that promote ethical behavior and societal harmony

UNIT 1 INTRODUCTION TO VALUE EDUCATION 6+3

Value Education – need and process, Self-Exploration – process, Basic Human Aspirations - Continuous Happiness and Prosperity, Basic requirement for fulfilment of Human Aspirants, Understanding Happiness and Prosperity – Continuity of Happiness from Physical Facility.

UNIT II HARMONY IN THE HUMAN BEING 6+3

Human being as a co-existence of the self and the Body - The needs of Self and Body, Body as an Instrument - The Self as the Seer- Doer-Enjoyer, Harmony in the self, Harmony of the Self with the Body –Programme for Self – regulation and health.

UNIT III HARMONY IN THE FAMILY AND SOCIETY 6+3

Family as the basic unit of human interaction , Understanding Relationship, Trust as the foundational value, Respect as the Right Evaluation, Harmony in the society – Understanding Human Goal, Harmony from Family Order to World Family Order – Universal Human Order - Scope.

UNIT IV HARMONY IN THE NATURE AND EXISTENCE 6+3

Nature - as Collections of Units, Classification of Units into Four Orders, Interconnectedness, and mutual fulfilment among the four orders of nature, self-regulation in Nature, Understanding Existence as Units in Space, Existence as Co-existence.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 6+3

Natural Acceptance of Human Values - Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Constitution, Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production System and Management Models – Typical case, Strategies for Transition towards value based life and profession.

TOTAL: (30+15) PERIODS

OUTCOMES:

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

- Understand the significance of value education and distinguish between values and skills
- Understand the concept of harmony within the self and how it relates to human values
- Analyze the role of family and society in fostering harmony
- Evaluate the relationship between human values and harmony in nature
- Develop skills to resolve conflicts and promote harmony in personal and professional life

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TEXT BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2nd Revised Edition, 2019.

REFERENCES:

1. Tripathi A N, "Human Values", New Age Intl. Publishers, New Delhi, 2009.
2. Govindarajan M, Natrajan S and Senthilkumar V S, "Engineering Ethics (Including HumanValues)" Eastern Economy, PHI, 12th Edition, 2011.
3. Govindarajan M and Natrajan S, "Professional Ethics and Human Values", PHI, 2011.
4. Banerjee B P, "Foundation of Ethics and Management", Excel Publication, 2005.
5. Bajpai B L, "Indian Ethos and Modern Management", New Royal Book Co, Lucknow,Reprinted 2008.
6. Seebauer and Robert L Berry, "Fundamentals of Ethics for Scientist and Engineers", OxfordUniversity Press, 2000.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	-	-	-	3
CO2	-	-	-	-	-	3	3	-	-	-	3
CO3	-	-	-	-	-	3	3	-	2	-	3
CO4	-	-	-	-	-	3	3	-	2	-	3
CO5	-	-	-	-	-	3	3	-	2	-	3

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24CY201	ENVIRONMENTAL SCIENCES (Common to All Branches)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand the structure and function of different ecosystems and concepts of biodiversity.
- Recognize the causes and effects of environmental pollutants and disaster management.
- Explore the natural resources and their sustainability.
- Examine the principles of sustainable development and Green Chemistry.
- Analyze the impacts of population on environment and human health.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment - concept of an ecosystem - structure and function of an ecosystem - ecological succession - food chain - food web - structure and function of the (a) forest ecosystem (b) desert ecosystem (c) aquatic ecosystem - (pond and ocean) - Biodiversity: Hot spots of biodiversity - threats to biodiversity - values of biodiversity - endangered and endemic species - conservation of biodiversity: In-situ and ex-situ conservation methods.

UNIT II ENVIRONMENTAL POLLUTION AND NATURAL CALAMITIES 9

Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) Nuclear hazards - solid waste and E-waste Management: role of an individual in prevention of pollution-disaster management: flood, earthquake, cyclone and landslides.

UNIT III NATURAL RESOURCES 9

Forest resources: deforestation, mining, dam and their effects on forest and tribal people - Water resources: Use and over - utilization of surface and ground water - dams-benefits and problems - Food resources: World food problems - effects of modern agriculture - fertilizer - pesticide problems, water logging, salinity - Energy resources: renewable energy sources - Solar energy, Tidal energy, Wind energy sources. Land resource: land degradation, Soil erosion and desertification - role of an individual in conservation of natural resources.

UNIT IV SOCIAL ISSUES AND SUSTAINABILITY 9

Water conservation - rain water harvesting- resettlement and rehabilitation of people; its problems and concerns - environmental ethics - acid rain, ozone layer depletion - waste land reclamation - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act – Forest conservation act. Sustainable development- Green Chemistry: Principles of green chemistry - Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transportation.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - value education - HIV / AIDS - threatening of communicable diseases for human population and its prevention - women and child welfare - role of information technology in environment and human health.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Articulate the significance of ecosystems and biodiversity.
- Evaluate the preventive measures of pollution and calamities.
- Identify the strategies for the conservation of natural resources.
- Retrieve the measures of green chemistry to real-world scenarios.
- Evaluate the issues of overpopulation and communicable diseases on the environment.

TEXT BOOKS:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, Delhi, 2nd Edition, 2018.
2. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 3rd Edition, 2016.

REFERENCES:

1. G. Tyler Miller, St. Andrews Preshyterian, "Introduction to Environmental Science", Cengage Learning India Pvt., Ltd., 2010.
2. Dharmendra S. Sengar, "Environmental Law", Prentice hall of India Pvt. Ltd, Delhi, 2007.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	3	2	-	-	-	-
CO2	2	2	-	-	-	3	3	-	-	-	-
CO3	-	1	3	-	2	3	-	-	-	-	-
CO4	2	-	3	-	3	-	3	-	-	-	-
CO5	1	2	-	-	-	2	-	-	2	-	-

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24GE101 COMPUTER FUNDAMENTALS AND C PROGRAMMING

(Common to All Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The Student should be made to:

- Learn the fundamentals of Computer and Programming.
- Understand the basics of C programming and decision making statements.
- Learn how to construct programs using array and pointer.
- Understand the concept of string and function.
- Study the concept of structure, union and files.

UNIT I FUNDAMENTALS OF COMPUTER AND PROGRAMMING 9

Computer System - Components of Computer Hardware - Data Representation - Number System and Conversion - Program Development Life Cycle - Algorithm - Control Structures - Flowchart – Pseudo code - Programming Paradigms.

UNIT II BASICS OF C PROGRAMMING 9

Overview of C - C Character Set - Identifiers and Keywords - Variable Declaration - Data types - Type Qualifiers and Type Modifiers - Structure of a C Program - Executing a C Program - Operators and Expressions - Decision-Making and Looping Statements.

UNIT III ARRAYS AND POINTERS 9

Introduction to Arrays - Types of Array - Pointers - void Pointer - Null Pointer - Arrays of Pointers - Pointer to a Pointer - Pointer to an Array - Pointer Arithmetic.

UNIT IV STRINGS AND FUNCTIONS 9

Strings - Reading String Input - String Library Functions - Command Line Arguments - Functions: Types - Declaration - Definition - Function Call - Pass by Value - Pass by Reference - Passing arrays to functions - Recursion.

UNIT V STRUCTURE, UNION AND FILES 9

Structures - Pointers to Structures - Array of Structures - Structures within a Structure - Functions and Structures - Unions - Storage Classes - Files: Streams - File type - File operations.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the fundamentals of computer and programming.
- Choose appropriate data types, variables and statements for solving simple problems.
- Construct programs using arrays and pointers for a given scenario.
- Build programs using strings and functions in C language.
- Develop programs using structure, union and files for a given scenario.

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Pearson India Education Services Pvt. Ltd., 2016.

REFERENCES:

1. Ajay Mital, "Programming in C - A Practical Approach", Pearson Education, 2015.
2. Dromey R G, "How to Solve it by Computer", Pearson Education, Fifteenth Impression, 2014.
3. Herbert Schildt, "C - The Complete Reference", Tata McGraw-Hill, 2013.
4. Ashok N Kamthane, "Computer Programming", Pearson Education, Second Edition, 2012.
5. Juneja B L and Anita Seth, "Programming in C", Cengage Learning India Pvt. Ltd., 2011.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	2	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	2	2	-
CO3	3	2	2	2	-	-	-	-	2	2	1
CO4	3	2	2	2	2	-	-	-	2	2	1
CO5	3	2	2	2	2	-	-	-	2	2	1

N. Ramesh

CHAIRMAN
BoS (IT) 27/11

24BM201 BIOSCIENCES FOR BIOMEDICAL ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to

- Apply biochemical principles to understand their roles in biological and clinical systems
- Utilize Carbohydrate and Lipid principles to understand their structure, function, and metabolic activities
- Integrate Amino acids, Proteins, and Nucleic acid concepts to understand their structure, functions, and significance.
- Implement the concepts of Cell injury, Repair, and Neoplasia to understand the factors influencing disease progression
- Utilize Microscopy, Microbiology, and Immunology concepts to assess Microbes, Viruses, and Immune responses.

UNIT I FUNDAMENTALS OF BIOCHEMISTRY 9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Maintenance of Blood pH,Handerson - Hassel Balch equation, Energy in living organism, Properties of water and their applications in biological systems .Osmosis: Definition, measurement of Osmotic pressure , Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II CARBOHYDRATES AND LIPIDS 9

Carbohydrates: Classification of carbohydrates – monosaccharide's-Glucose, oligo and polysaccharides. Structure and properties of carbohydrates- Functions of carbohydrates. Lipids: Classification of lipids-Functions. Fatty acids- Nomenclature of Fatty acids-Phospholipids-Glycolipids-Lipoproteins-Amphipathic Lipids and their biological significance.

UNIT III AMINO ACIDS AND PROTEINS 9

Amino acids: Classification – Based on structure and chemical nature, nutrition and solubility properties of amino acids, Functions of amino acids. Proteins: Classification- Structure-primary, secondary and tertiary. Properties of proteins, Nucleotides and Nuclei acids: Structural aspects – Functions – DNA- Watson-Crick model of DNA structure- RNA- Types- m-RNA t-RNA.

UNIT IV CELL DEGENERATION, REPAIR AND NEOPLASIA 9

Cell injury: Reversible cell injury-Mechanism of cell injury , Cell death- Necrosis, Apoptosis, Hypoxia and Ischemia-Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic, Cellular ageing.Repair:Cell regeneration, Factors influencing tissue repair, Wound healing. Neoplasia: Benign and Malignant tumors, genetic and epigenetic of carcinogenesis, Carcinogenic agents and their cellular interactions.

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UNIT V FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY 9

Microscopes: Light microscope, Electron microscope-TEM & SEM. Bacteria: Morphology, Pathogenicity, Epidemiology and Laboratory Diagnosis. Virus: Morphology, Classification-DNA and RNA virus, Viral Multiplication. Immunity: Types- Innate and Acquired immunity- Antigen and Antibodies - Antigen-Antibody Reactions-Immune Response- Production of antibodies, Hypersensitivity, Immunodeficiency diseases.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate the ability to analyze and solve biochemical problems in biological applications
- Analyze the properties, functions, and clinical relevance of carbohydrates and lipids in energy storage, structure, and signaling.
- Assess the classification, structure, and roles of Amino acids, Proteins, and Ncleic acids in genetics.
- Illustrate the processes of cell damage, regeneration, wound healing, and tumor development
- Evaluate microbial structures, viral replication, and immune functions in disease diagnosis

TEXT BOOKS:

1. RAFI MD "Textbook of biochemistry for Medical Student" 4th Edition, Universities Press,Orient Black swan Private Limited - New Delhi 2021.
2. U. Satyanarayana & U. Chakrapani "Biochemistry" 5th Edition , Elsevier, 2019.
3. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases",10th edition: South Asia Edition Elsevier India, 2020.
4. Ananthanarayanan & Panicker, "Microbiology" Orient black swan, 10th edition, 2017.

REFERENCES:

1. Keith Wilson & John Walker, "Practical Biochemistry -Principles & Techniques", Oxford University Press, 2009.
2. Dubey R C and Maheswari DK. "A Text Book of Microbiology" S Chand & Company Ltd, 2007.
3. Prescott , Harley and Klein, "Microbiology", 10th edition, Mc Graw Hill, 2017

COURSEOUTCOME Versus PO&PSO MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1)**:**

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

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BoS/BME

24TA201	TAMILS AND TECHNOLOGY (Common to All Branches)	L T P C 1 0 0 1

OBJECTIVES:

Students should be made to:

- Gain knowledge about weaving and ceramic Technology
- Creating a design and construction Technology
- Analyzing manufacturing Technology
- Applying agriculture and irrigation Technology
- Remembering scientific and scientific Tamil and Tamil computing

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo -Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Sheil beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing Knowledge of Sea - Fisheries– Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

OUTCOMES:

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

- Understand weaving under ceramic Technology.
- Develop new design and construction Technology.
- Identify the manufacturing Technology.
- Understand agriculture and irrigation.
- Knowledge of scientific Tamil and Tamil computing.

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TEXT-CUM-REFERENCE BOOKS

1. தமிழகவரலாறு - மக்களும்பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	1	-	-	1
CO2	-	-	-	-	-	-	2	1	-	-	1
CO3	-	-	-	-	-	-	2	1	-	-	1
CO4	-	-	-	-	-	-	2	1	-	-	1
CO5	-	-	-	-	-	-	2	1	-	-	1

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24TA201	தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவானது)	L T P C 1 0 0 1

நோக்கம்:

மாணவர்கள் கண்டிப்பாக அறிய வேண்டுவன:

- நெசவு மற்றும் பீங்கான் தொழில்நுட்பம் பற்றிய அறிவைப் பெறுதல்.
- வடிவமைப்பு மற்றும் கட்டுமான தொழில் நுட்பத்தை உருவாக்குதல்.
- உற்பத்தி தொழில் நுட்பத்தை பகுப்பாய்வு செய்தல்.
- விவசாயம் மற்றும் நீர்ப்பாசனத் தொழில் நுட்பத்தைப் பயன்படுத்துதல்.
- அறிவியல் மற்றும் அறிவியல் தமிழ் மற்றும் தமிழ் கணிப்பொறி தொடர்பான அறிவை நினைவில் கொள்ளுதல்.

அலகு 1 நெசவு மற்றும் பானை தொழில் நுட்பம் 3

சங்க காலத்தில் நெசவுத்தொழில் - பானை தொழில் நுட்பம் - கருப்பு, சிவப்பு பாண்டங்கள் - பாண்டுகளில் கீறல் குறியீடுகள்.

அலகு 2 வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் &சங்ககாலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுக்கல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலதது பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் நாயக்கர் கால கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை.

அலகு 3 உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்பு தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடிகள் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்பு துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம் 3

அணை, குளங்கள், மதகு - சோழர்கால குமுளி தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்து குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

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அலகு 5 அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

முடிவுகள்:

பாடத்தின் முடிவில், மாணவர்கள் அறிந்து கொள்வன:

- பீங்கான் மற்றும் நெசவு தொழில்நுட்பத்தைப் புரிந்து கொள்ளுதல்.
- புதிய வடிவமைப்பு மற்றும் கட்டுமான தொழில் நுட்பத்தை உருவாக்குதல்.
- உற்பத்தித் தொழில் நுட்பத்தை அடையாளம் காணுதல்.
- விவசாயம் மற்றும் நீர்ப்பாசனத்தைப் புரிந்து கொள்ளுதல்.
- அறிவியல் தமிழ் மற்றும் தமிழ் கணிப்பொறி தொடர்பான அறிவை பெறுதல்.

உரை மற்றும் குறிப்பு புத்தகங்கள்:

1. தமிழகவரலாறு - மக்களும்பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	1	-	-	1
CO2	-	-	-	-	-	-	2	1	-	-	1
CO3	-	-	-	-	-	-	2	1	-	-	1
CO4	-	-	-	-	-	-	2	1	-	-	1
CO5	-	-	-	-	-	-	2	1	-	-	1

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24GE103L	C PROGRAMMING LABORATORY (Common to All Branches)	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The Student should be made to:

- Learn how to develop C programs using conditional and looping statements
- Understand the concept of functions, arrays and strings
- Learn how to access memory using pointers
- Group different kinds of data related to a single entity
- Understand the manipulation of data in permanent storage

LIST OF EXPERIMENTS:

1. Programs using decision making statements.
2. Programs using looping statements.
3. Programs using user defined functions and recursive functions.
4. Programs using one dimensional and two dimensional arrays.
5. Solving problems using string functions.
6. Programs using pointers and dynamic memory allocation.
7. Programs using structures and unions.
8. Programs using pointers to structures and other data types.
9. Programs using text files.
10. Programs using binary files.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Implement C programs using control statements.
- Write C programs using functions, arrays and strings.
- Write C programs to access data in memory using pointers.
- Develop C programs using structures and other user defined data structures to manipulate heterogeneous data.
- Build C programs to manipulate data stored on permanent storage.

List of Equipment for a Batch of 30 Students:

- Standalone desktops with C compiler or Server with C compiler for 30 Nos.

Mapping of COs with POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	-	-	-	2	3	-	-
CO2	3	2	3	2	-	-	-	2	3	-	-
CO3	3	2	3	2	-	-	-	2	3	-	2
CO4	3	2	3	2	2	-	-	2	3	-	2
CO5	3	2	3	2	2	-	-	2	3	-	2

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24BM202L	BIOSCIENCES LABORATORY	L T P C 0 0 3 1.5

OBJECTIVES:

The students should be made to:

- Experiment with various laboratory solution, buffers and emulsions and standardize by using spectroscopy
- Identify the presence of Carbohydrates, Proteins, and Lipids in the given samples
- Demonstrate blood collection and preparation of Serum and Plasma
- Analyze biochemical parameters in the blood and Urine for clinical assessment
- Apply staining techniques to analyze Microorganisms and Pathological samples

LIST OF EXPERIMENTS:

1. Preparation of solutions: a) percentage solutions, b) molar solutions, c) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: Determination of absorption maxima (λ_{max}) of a given solution
4. General tests for carbohydrates, proteins and lipids.
5. Identification of blood sample Collection and Preparation of serum and plasma from blood.
6. Estimation of Glucose, Creatinine, Urea and Uric acid
7. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
8. Study of Staining Techniques
    a) Simple staining.
    b) Gram Staining.
    c) AFB Staining
9. Study of Histopathological slides of benign and malignant tumors and Haematology slides of anemia and leukemia.
10. Antigen – Antibody reaction immune electrophoresis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Develop solution for testing, standardize based on pH values and use Spectroscopy effectively for analysis
- Detect and differentiate between Carbohydrates, Proteins, and Lipids from the biological samples
- Differentiate and process Serum and Plasma effectively
- Perform tests for determining the values of complete Glucose, Creatinine, Urea, Uric Acid, and Urine components
- Evaluate histopathological and hematology slides for disease identification

Text Books:

1. Textbook of Medical Laboratory Technology, Ramnik Sood, 6thEdition, Jaypee Brothers Medical Publishers, 2009

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COURSE OUTCOME Versus PO&PSO MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

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

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24EEC201L PROFESSIONAL COMMUNICATION LABORATORY L T P C
(Common to All Branches) 0 0 2 1

OBJECTIVES:

The students should be made to:

- Establish effective time management techniques and professional grooming routines.
- Make progress on their own presentations by utilizing visual aids and interacting with the audience.
- Obtain the ability to participate in group conversations effectively and comprehend group dynamics.
- Recognize the protocol required for different types of interviews.
- Develop strategies for stress management, time management, and professional networking.

UNIT I SOFT SKILLS DEVELOPMENT **6**

Introduction to Soft Skills - Hard skills & soft skills - Employability and Career Skills - Grooming as a professional with values - Time Management - General awareness of Current Affairs.

UNIT II DEVELOPING SELF ESTEEM **6**

Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice - presenting the visuals effectively - Five minutes presentation

UNIT III PROFESSIONAL SKILLS **6**

Introduction to Group Discussion - Participating in group discussions - understanding group dynamics - brainstorming the topic - questioning and clarifying - GD strategies - activities to improve GD skills

UNIT IV COMMUNICATION ETIQUETTES **6**

Interview etiquette - dress code - body language - attending job interviews - telephonic interview - one to one interview & panel interview - FAQs related to job interviews

UNIT V MANAGEMENT SKILLS **6**

Recognizing the differences between groups and teams - managing time - managing stress-networking professionally- respecting social protocols - understanding career management-developing a long- term career plan-making career changes.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Develop employability skills such as communication, teamwork, adaptability, and problem-solving.
- Enhance confidence and competence in answering questions effectively during presentations and discussions.
- Apply group discussion techniques and real-world exercises to improve debating abilities.
- Prepare for various job interviews, including panel, one-on-one, and telephone interviews.
- Formulate a comprehensive career plan, focusing on networking and career progression.

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Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	3	2	-	3
CO3	-	-	-	-	-	-	-	2	3	-	3
CO4	-	-	-	-	-	-	-	3	3	-	3
CO5	-	-	-	-	-	-	-	3	2	-	2

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LIST OF EQUIPMENTS
Requirements for a batch of 30 students

Sl. No.	Description of Equipment/Software	Quantity required (Nos)
1	Computer	30
2	Headphones	30
3	**Software:** Globarena	30

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24MA303 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
(Common to BME, CIVIL, EEE, ECE and MECH) 3 1 0 4

OBJECTIVES:

The Student should be made to:

- Understand the basic concepts of PDE for solving standard partial differential equations
- Remember the concepts of fourier series for solving problems in engineering disciplines
- Applying the standard techniques for solving boundary value problem
- Analyze Fourier transform techniques used in wide variety of situations
- Evaluate the Z transform techniques for discrete time systems

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations(single functions only) - Singular integrals -Solutions of standard types of first order partial differential equations(four types) - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients of homogeneous Equations.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range sine series - Half range cosine series - Complex form of Fourier series - Parseval's identity - Harmonic analysis.

UNIT III FOURIER TRANSFORMS 9+3

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

UNIT IV 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.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties - Inverse Z-transform - Partial fraction - Convolution theorem (Statement and Examples) - Initial and final value theorems - Formation of difference equations - Solution of difference equations using Z-transform.

TOTAL: (45+15) PERIODS

OUTCOMES:

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

- Understand suitable concepts in solving first order and second order partial differential equations with constant coefficients
- Identify the Fourier series for standard periodic waveforms
- Apply the solutions of wave and heat equations using Fourier series
- Analyze the properties and techniques of Fourier transforms
- Evaluate the necessary Z transform techniques to solve the difference equations

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TEXT BOOKS:

1. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Edition, Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
2. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2017.

REFERENCES:

1. Bali N.P and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications(P) Ltd., 9th Edition, 2016.
2. Ramana B V, "Higher Engineering Mathematics", New Delhi Tata McGraw- Hill Education India Private Limited., 2018.
3. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.
4. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2011.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	-	2	-	2	-	-	2
CO2	3	2	2	-	-	2	-	2	-	-	2
CO3	3	3	3	2	-	2	-	2	-	-	2
CO4	3	2	2	-	-	1	-	2	-	-	2
CO5	3	2	3	2	-	1	-	2	-	-	2

CHAIRMAN
BoS (S&H) 14/10

24BM301	HUMAN ANATOMY AND PHYSIOLOGY	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Integrate the individual functions of all the cells, tissues and organs into a functional whole human body.
- Identify the Bones, Joints and Functions and Muscular Movements.
- Emphasize the constituents of Blood, cardiovascular and respiratory system and its functions
- Outline the importance of digestion, absorption and mechanism of Urinary system
- Identify and classify the functions of nervous and various sensory organs of the human body

UNIT I BASIC ELEMENTS OF HUMAN BODY 9

Cell – Cell Structure – Functions of components of cell. Cell membrane – Fluid mosaic model-transport across cell membrane – Action potential – Homeostasis - Cell Division -Tissue: Types, functions.

UNIT II SKELETAL AND MUSCULAR SYSTEM 9

Skeletal: Types of Bone and function –Structure of long bone- Physiology of Bone formation – Division of Skeleton -Types of joints and function – Joint disorders - Types of cartilage and function. Muscular: Types of muscles –Functions- Muscle movements - Muscle contraction-Neuromuscular junction.

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM 9

Blood: Components and Functions – Hematopoiesis - Haemostasis – Blood groups. Cardiovascular System: Structure of heart – Conduction System of heart – Cardiac Cycle and heart sounds. Lymphatic System: Lymphatic vessels - Lymph node - lymphoid organs - Respiratory system: Organs of respiratory system – Mechanism of breathing – Lung volumes and capacities – Gaseous exchange.

UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS 9

Digestive system: Organs of digestive system – digestion and absorption – Nutrition and metabolism – Krebs cycle. Urinary System: structure of kidney - nephron - mechanism of urine formation - Micturition- Maintaining water and electrolyte balance of blood.

UNIT V NERVOUS AND SENSORY SYSTEM 9

Nervous tissue: Structure and function of cells of nervous system - Nerve conduction and synapse Brain - spinal cord – Reflex action – Somatic and Autonomic Nervous system. Eye: Structure - Physiology of Vision. Ear: structure - Physiology of Hearing. Integumentary – Structure of skin-Appendages of the skin.

TOTAL: 45 PERIODS

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OUTCOMES:

On Successful completion of this course, students will be able to,

- Appreciate the functional importance of Cells, Tissues and Organs of Human Body
- Classify the types of Bones, Joints and Muscle characteristics
- Interpret the functions of the Blood, Heart, Lymphatic and Respiratory systems
- Extend the knowledge of digestion and urinary system to built artificial organs
- Translate the brain functions and sensory organs into appropriate wave patterns through appropriate instruments

TEXT BOOKS:

1. Elaine N Marieb," Essential of Human Anatomy and Physiology" Tenth Edition, Pearson Education, 2013.

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. SaradaSubramanyam, K MadhavanKutty, Singh H D, "Textbook of Human Physiology", 0S. Chand and Company Ltd, New Delhi, 2012.

Mapping of COs with POs and PSOs

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

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24BM302	MEDICAL PHYSICS	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Illustrate the principles, effects of ionizing and non-ionizing
- Interpret the physics of radiation sound, ultrasound interaction and its clinical applications
- Develop an understanding of the principles of radionuclides and its uses in medicine
- Organize the interaction of particles, X and Gamma radiation with matter
- Demonstrate the significance of dose measurement, detectors and counters

UNIT I IONIZING AND NON-IONIZING RADIATION 9

Electromagnetic spectrum - Generation of ionizing radiation – Production of X-rays - Linear accelerator - Tele-isotope - Absorption, Scattering and Attenuation of Gamma-rays –Biological effects and Protection. Non ionizing radiation: Physics of light - Intensity of light - Tissue as a leaky dielectric - Low Frequency Effects- Higher frequency effects.

UNIT II 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

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 9

Radioactive Decay: Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture. - Radionuclide used in Medicine - Decay series: Half-life and Mean life - Decay equation. Production of radionuclides: Cyclotron - Reactor produced - fission and neutron capture reaction - radionuclide Generator-Technetium generator

UNIT IV INTERACTION OF RADIATION WITH MATTER 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 V RADIATION DOSE AND DETECTORS 9

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the dosimetric quantities. Measurement Methods: Principles of Gas-Filled Detectors - Ionization chambers - Geiger–Müller Counters - Scintillation counters - Film dosimeters - Thermo luminescent dosimetry(TLD). Scintillation Detectors: Solid Scintillation Counters - Gamma-Ray Spectrometry - Liquid Scintillation Counters - Gamma Well Counters-Thyroid Probe.

TOTAL: 45 PERIODS

Chairman
BoS/BME 19/08/25

OUTCOMES:

On Successful completion of this course, students will be able to,

- Interpret the properties of electromagnetic radiations and its effect on human.
- Demonstrate the knowledge on the properties of sound and its application in medicine.
- Apply the principles and understand the production of radioactive nuclides.
- Explain the interaction of radiation with matter.
- Identify and analyze the radiation quantities and methods of measuring

TEXT BOOKS:

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. 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.

Mapping of COs with POs and PSOs

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

Chairman
BoS/BME

24EC201 ELECTRIC CIRCUITS AND ELECTRON DEVICES (Common to ECE and BME)

L	T	P	C
3	0	0	3

OBJECTIVES:

Student should be made to

- Understand the basic electrical quantities, circuit elements, and fundamental laws governing electrical circuits.
- Able to simplify electrical circuits using various network theorems and two-port parameter concepts.
- Learn the behavior of RL, RC, and RLC circuits under transient conditions using Laplace transform techniques.
- Provide insights into semiconductor diodes, their characteristics, and applications in electronic circuits.
- Explore the working principles of BJTs, JFETs, and MOSFETs, along with their role in amplification and switching circuits

UNIT I BASIC CIRCUIT ANALYSIS 9

Electrical Quantities -Basic Circuit Elements -Independent Voltage and Current Sources - Ohm's Law- Kirchhoff's Laws -Voltage and Current Division, Source Transformation Star Delta Conversion- Mesh analysis and Nodal analysis for DC Circuits - Fundamentals of AC Circuits.

UNIT II NETWORK THEOREMS AND TWO PORT NETWORKS 9

Network Theorems for DC Circuits: Thevenin's Theorem Norton's Theorem- Superposition Theorem Maximum Power Transfer Theorem Two Port Networks: Z Parameters – Y Parameters - h Parameters - Relationships between Network Parameters (Z, Y, h).

UNIT III TRANSIENT RESPONSE ANALYSIS 9

Introduction to Laplace transform for step, impulse and periodic functions-Transient Response of RL, RC and RLC Circuits using Laplace transform for DC input and AC sinusoidal input.

UNIT IV SEMICONDUCTOR DIODES AND DEVICES 9

Classification of Semiconductors – PN Junction Diode -Structure, Operation and V-I characteristics -Diode Current equation -Transition and Diffusion Capacitances Zener Diode LED-Photodiode-Solar Cell -UJT-SCR.

UNIT V TRANSISTORS 9

Bipolar Junction Transistor: Construction of BJT-Operation of NPN and PNP transistor - Input and Output characteristics of CB, CE, CC configuration- Field Effect transistor: JFET P Channel JFET and N Channel JFET Construction, Operation, Drain and Transfer characteristics MOSFET Depletion MOSFET and Enhancement MOSFET - Construction, Operation and characteristics.

TOTAL: 45 PERIODS

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BoS(ECE) 22/08/25

OUTCOMES:

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

- Recognize fundamental circuit laws and theorems to solve DC electrical circuits.
- Illustrate the use of Thevenin's, Norton's, and Superposition theorems for circuit simplifications.
- Interpret the behavior of RL, RC, and RLC circuits under DC and AC inputs using Laplace Transform techniques.
- Examine the characteristics and functions of diodes, Zener diodes, LEDs, photodiodes, solar cells, and thyristors.
- Categorize the working principles, characteristics, and applications of BJTs, JFETs, and MOSFETs in different circuit configurations.

TEXT BOOKS:

1. S. Salivahanan, "Circuit Theory Analysis and Synthesis", Pearson Education,1 st Edition,2021.
2. S. Salivahanan, "Electronic Devices", Tata McGraw Hill, 1st Reprint Edition, 2014.

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Sathesis", 5 thEdition, McGraw Hill, 2015.
2. Chakrabarti A, "Circuit Theory (Analysis and synthesis), Revised Edition, Dhanpath Rai & Sons, New Delhi, 2017.
3. Balbir Kumar, Shail. B. Jain, "Electronic devices and circuits", 2nd Edition PHI learning private limited, 2014.
4. David A. Bell, "Electronic devices and circuits", 5th Edition, Oxford University Higher education, 2008.
5. Sedra and Smith, "Microelectronic circuits", 7th Edition, Oxford University Press, 2017
6. Thomas L. Floyd, "Electronic devices" Conventional current version, 10th Edition, Pearson prentice hall, 2017.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	1	1	-	-	-	2
CO2	3	3	2	2	2	1	1	-	-	-	2
CO3	3	3	2	2	2	1	1	-	-	-	2
CO4	3	2	1	1	-	1	1	-	-	-	2
CO5	3	2	1	1	-	1	1	-	-	-	2

Chairman
BoS(ECE)

24BM303 ELECTRICAL ENGINEERING FOR BIOMEDICAL **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Apply the principles of magnetic circuits and transformer operation to analyze the electromagnetic behaviour.
- Illustrate the constructional and operational principles of DC machines to determine their performance.
- Assess the principles of AC and special electrical machines to determine their effectiveness in control and instrumentation systems
- Employ electrical safety standards and protective device principles to design safe and reliable hospital electrical systems.
- Implement power system fundamentals and safety protocols to ensure reliable power delivery and patient protection in a clinical setting.

UNIT I MAGNETIC CIRCUITS AND TRANSFORMERS **9**

Ampere's law - Magnetic quantities- Series and parallel magnetic circuits - Magnetic materials and B-H relationship - Electromagnetic induction - Self and mutual induction- Losses in magnetic circuits. Transformer: Construction and operation of single-phase transformer - Ideal transformer- Autotransformer.

UNIT II DC MACHINES **9**

DC Machines: Construction, Principle of operation, armature windings, EMF equation, Torque equation, Operation of a DC machine as a generator and motor - Characteristics of DC generators and motors.

UNIT III AC MACHINES AND SPECIAL MACHINES **9**

Three phase induction motor: Construction, principle of operation. Single phase induction motor: Construction, working principle and types. Synchronous Generator: Construction, Principle of operation, Synchronous motor: principle and operation. Servomotor- Stepper Motor.

UNIT IV ELECTRICAL SAFETY DEVICES FOR HOSPITALS **9**

Two-way and three-way control, Elementary discussion on circuit protective devices - Fuse and Miniature Circuit Breaker (MCB's), Electric shock, precautions against shock, Objectives for neutral and earthing, Types of earthing - Pipe and Plate earthing, Residual current circuit breaker.

UNIT V ELECTRICAL POWER SYSTEM AND PATIENT SAFETY **9**

Introduction - Power generation, Distribution and Transmission, Power tariffs, Power supply circuits with SMPS, UPS, Electric Shock Hazards, Leakage Currents, Electrical Safety Analyser, Testing of biomedical equipment, Transducers for body temperature measurements.

TOTAL: 45 PERIODS

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BoS/BME 19/08/25

OUTCOMES:

At the end of this course, the students will be able to:

- Demonstrate the application of magnetic circuit analysis, and transformer principles to assess electromagnetic induction and its functionality
- Analyze the construction, equations, and operational characteristics of DC generators and motors to evaluate their suitability for varied load conditions
- Solve application-based problems involving induction motors and synchronous machines by applying their functional principles.
- Recommend appropriate protective devices and earthing practices to ensure electrical safety and prevent shock hazards in healthcare.
- Interpret power systems, safety mechanisms and biomedical equipment testing procedures to enhance patient safety in hospital settings.

TEXT BOOKS:

1. Kothari D P and Nagarath I J, "Basic Electrical and Electronics Engineering", 3rd Reprint, McGraw Hill Education (India) Private Limited, 2016.
2. Gupta J B, "A course in Power Systems", S K Kataria and Sons, 2016.

REFERENCES:

1. B.L.Theraja, "A Textbook of Electrical Technology", S Chand and Company- Reprint Edition, 2014.
2. V.K Mehata, Rohit Mehta, "Principles Electrical Engineering and Electronics", 2nd edition, S Chand and Company, 2015.
3. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rd edition, McGraw Hill Education (India) Private Limited, 2023.

Mapping of COs with POs and PSOs

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

Chairman
BoS/BME

24AD201	PYTHON PROGRAMMING (Common to ADS, CSE, IT and BME)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Acquire knowledge about the fundamentals of Python language
- Learn to solve problems using Python conditionals , loops and use functions to solve problems
- Apply Python data structures - lists, tuples and dictionaries to represent complex data
- Enhance the knowledge in GUI Programming
- Build application that handles files and exceptions

UNIT I INTRODUCTION TO PYTHON 9

Programming Languages - Python History - Getting Started with Python - Writing a Simple program - Reading input from console - Identifiers - Variables - Simultaneous Assignments - Constants - Data Types and Operators - Operator Precedence - Evaluating expressions - Augmented Assignment operators - Type conversion - Common Python Functions - Strings and Characters - Formatting Numbers and Strings.

UNIT II CONTROL STATEMENTS AND FUNCTIONS 9

Selections: if - Two way if-else - Nested if and multi-way if-elif-else Statements - Loops: while - for - Nested Loops - break and continue - Function: Definition - Calling and Returning values - Positional and keyword arguments - Passing arguments by reference values - Scope of variables - Default Arguments - Recursion.

UNIT III DATA STRUCTURES IN PYTHON 9

List Basics - List Methods - Passing List to Functions - Returning a List from function - Tuples - Sets - Comparing Sets and Lists - Dictionaries.

UNIT IV GUI PROGRAMMING USING PYTHON 9

Introduction - Getting started with TKinter - Processing Events - The widget Classes - Canvas - The Geometry Managers. Combo Boxes - Menus - Pop-up menus - Mouse, key, Events and Bindings. Case Study: Bouncing Balls - Scrollbars - Standard Dialog Boxes.

UNIT V FILES AND EXCEPTION HANDLING 9

Introduction - Text Input and Output - File Dialogs - Retrieving Data from the Web - Exception Handling - Raising Exceptions - Processing Exception using Exception Objects.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the basics of python programming languages
- Apply basic Python programs that solve issues by utilizing loops and conditionals
- Demonstrate compound data using Python lists, tuples and dictionaries etc
- Implement solutions using GUI Programming in Python
- Develop programs by using files and exception handling for the given scenario

CHAIRMAN
BoS (AD) 26/11

TEXT BOOKS:

1. Y.Daniel Liang, "Introduction to Python Programming and Data Structures", 3rd Edition Pearson Education, 2023.

REFERENCES:

1. Timothy A. Budd, "Exploring Python", McGraw Hill Education (India) Private Ltd, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/)
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Mark Lutz, "Learning python", O'Reilly Publication, 5th Edition, 2013.
5. Guido Van Rossum and Fred L. Drake Jr, "An Introduction to Python", Revised and Updated for Python 3.2, Network Theory Ltd., 2011.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	-	-	-	2	-	-	3
CO2	3	3	3	3	3	-	-	-	-	2	-
CO3	3	2	3	-	-	-	-	2	-	-	2
CO4	3	2	3	-	2	-	-	2	-	-	3
CO5	3	2	3	-	-	-	-	2	-	-	2

CHAIRMAN
BoS (AD)

24BM304L **HUMAN PHYSIOLOGY LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES:

The student should be made to:

- Identify and understand the various parts of a compound microscope.
- Comprehend the principles behind blood grouping and Rh factor
- Estimate the coagulation pathways and the role of various factors in the clotting proc
- Classify the constituents of blood and measure the quantity
- Analyze the visual and hearing levels of a human

LIST OF EXPERIMENTS:

1. Study of compound microscope.
2. Identification of Blood groups (Forward and Reverse)
3. Measurement of Bleeding and Clotting time of blood.
4. Prothrombin time Activated partial thromboplastin time and Fibrinogen time.
5. Estimation of Hemoglobin
6. Calculation of total RBC & WBC count.
7. Differential count of Blood cells
8. Estimation of ESR, PCV, MCH, MCV, MCHC
9. Testing the Hearing levels using Tuning fork.
10. Visual Activity – Snellen's Chart and Jaeger's Chart

TOTAL: 30 PERIODS

OUTCOMES:

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

- Demonstrate various parts of a compound microscope and know how to operate
- Identify the types of blood group, Rh type and its significance
- Examine the bleeding time & clotting time of blood
- Identify the RBC, WBC along with its quantity and compare it with nominal value
- Infer the efficiency of visualization and hearing sensory organs

Mapping of COs with POs and PSOs

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

Chairman
BoS/BME 19/08/25

24EC202L	CIRCUITS AND DEVICES LABORATORY (Common to ECE and BME)	L T P C 0 0 3 1.5

OBJECTIVES:

The student should be made to:

- Learn and verify the voltage and current in the electrical circuit using Kirchhoff's laws
- Apply circuit analysis concepts using network theorems
- Analyze the operation of RLC circuits in series and parallel models
- Evaluate the characteristics, behavior under varying conditions, and practical applications of diodes and transistors in electronic circuits and devices.
- Create a project using electronic components

LIST OF EXPERIMENTS:

1. Verification of KVL and KCL.
2. Verification of Thevinin's and Norton's Theorem.
3. Verification of Super Position Theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Simulation and Verification of Reciprocity Theorem.
6. Determination of Resonance Frequency of Series and Parallel RLC Circuits.
7. Characteristics of PN Junction Diode and Zener Diode
8. Input-Output Characteristics of CE Configuration.
9. Simulation of LED Characteristics.
10. Characteristics of FET.
11. Characteristics of SCR.
12. Mini Project

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Contrast Kirchhoff's laws to verify the voltage and current.
- Determine the network theorems allows for the efficient solution of voltage, current or resistance in complex circuits.
- Illustrate the operation of RLC circuits in series and parallel models enables the analysis of resistive, inductive and capacitive components.
- Implement the characteristics of semiconductor diodes and transistors.
- Demonstrates the ability to design, assemble, and troubleshoot electronic circuits, showcasing problem-solving skills and practical application of electronic principles.

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BoS(ECE) 04/05/26

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	-	2	-	2	2	-	1
CO2	3	3	2	1	2	2	-	2	2	-	1
CO3	2	2	3	2	-	2	-	2	2	1	1
CO4	2	2	3	2	2	2	-	2	2	1	1
CO5	2	1	2	1	-	2	-	2	2	2	1

CHAIRMAN
BoS(ECE)

Lab Requirements for a Batch of 30 Students

1.	BC 107, BC 148, BFW10	25 Each
2.	1N4007, SCR, Zener diodes	25 Each
3.	Resistors, Capacitors, Inductors	Adequate Quantities
4.	Digital Multimeter	10 Nos
5.	Bread Boards	15 Nos
6.	Voltmeter (0-15)V, (0-10)V	10 Nos
7.	Ammeter (0-20) mA, (0-250) μA	10 Nos
8.	CRO (30 MHz)	10 Nos
9.	Function Generators (3 MHz)	10 Nos
10.	Regulated Power Supplies (0-30) V	15 Nos
11.	Standalone desktops PCs with Multisim Software (Equivalent to any open source Software)	15 Nos

CHAIRMAN
BoS (ECE) 22/08/25

24AD202L	PYTHON PROGRAMMING LABORATORY (Common to ADS, CSE, IT and BME)	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The Student should be made to:

- Use control statements and operators in Python programs
- Create python programs using functions and strings
- Represent compound data using Python lists, dictionary and set
- Build python GUI Application with Tkinter
- Design python applications to handles files and exceptions

LIST OF EXPERIMENTS:

1. Python Program to constructs conditional statements.
2. Python Program to implement operators and built in functions.
3. Python Program to performing string operations.
4. Python Program to find the factorial of a number by using functions.
5. Python Program to manipulating the elements on list.
6. Python Program to develop a fundamental data structures in programming using dictionary and set.
7. Python program to Controlling Layout with Geometry Managers.
8. Python Program to display the calendar of the year with GUI using Tkinter.
9. Python Program to perform count the number of words in a file.
10. Python Program to implement exception handling.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Solve the problems using control statements and operators in python
- Construct python program using strings and functions
- Design Python lists, dictionary and set to represent compound data
- Apply Tkinter to develop GUI Application
- Develop python programs using file and exception handling

List of Equipment for a Batch of 30 Students:

Standalone desktops with Python 3 interpreter for Windows/Linux 30 Nos.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	2	-	-	2	-	-	-
CO2	3	3	3	2	-	-	-	2	-	-	-
CO3	3	2	2	-	-	-	-	2	-	-	-
CO4	3	3	3	-	2	-	-	2	-	-	2
CO5	3	3	3	-	2	-	-	2	-	-	2

CHAIRMAN
BoS (AD) 26/11

24EEC301L	SOFT SKILLS DEVELOPMENT (Common to All Branches)	L T P C 0 0 2 1

OBJECTIVES:

The students should be made to:

- Enhance the development of students by focusing on soft skills
- Develop skills of the students through individual and group activities
- Shape students' attitude and behaviour through activities
- Analyze the characteristics of the students for self-development
- Prepare themselves for the recruitment processes

UNIT I SOFT SKILLS ARE IMPORTANT FOR SUCCESS 6

Importance of Soft Skills - Types - Industrial needs - Development of skills – Employees' expectation - Success of employees.

UNIT II CORPORATE COMMUNICATION 6

Needs and Development of Communication - Customers Relationship - Improving informal communication - Formation of presentations - Public Speaking - Telephone and Email Etiquettes.

UNIT III DISCUSSIONS 6

Introduction to Discussion - Importance and types of discussion - Spontaneous conversation - Plan for discussions - Panel discussions - Visual Aid discussions - Debate.

UNIT IV SELF ANALYSIS 6

Who am I - Identifying or searching one's own Strength, Weakness - Opportunities and Threats (SWOT Analysis) - Benefits of SWOT Analysis - Importance of Self Confidence, Self Esteem, Self Development and Self Introspection.

UNIT V CREATIVITY AND GOAL SETTING 6

Thinking out of the box - Lateral thinking - Positive thinking - Results of smart work - Application of creativities - Short Term and Long Term Goals - Lifetime goals.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Learners will recognize the importance of Soft skills in Professional life.
- Improve oral and Listening Skills.
- Enhance students' ability in GDs, Presentations and interviews.
- Develop one's strength in setting of goals and developing creative.
- Become a good team worker in the society.

CHAIRMAN
BoS (S&H) 14/10

TEXT BOOKS:

1. "SOFT SKILLS", Career Development Centre, Green Pearl Publications, 2015.

REFERENCES:

1. Covey Sean, "Seven Habits of Highly Effective Teens", New York, Fireside Publishers, 1998.
2. Carnegie Dale, "How to win Friends and Influence People", New York: Simon & Schuster, 1998.
3. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, 2011.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	2	2	-	2	2	-	-
CO2	-	3	-	3	2	-	3	2	2	2	2
CO3	2	-	-	-	3	-	2	3	2	2	2
CO4	2	-	2	-	-	2	-	3	2	3	-
CO5	-	3	2	1	-	2	2	3	2	-	-

CHAIRMAN
BoS (S&H)
14/10

24MA403	PROBABILITY AND STATISTICS (Common to ADS, BME and IT)	L T P C 3 1 0 4

OBJECTIVES:

The Student should be made to:

- Introducing the basic concepts of probability and random variables
- Understand discrete and continuous random variables and their probability distributions
- Apply the testing of hypothesis for small and large samples which plays an important role in real life problems
- Evaluating the basic concepts of classifications of design of experiments
- Creating the statistical tools and statistical quality control in engineering problems

UNIT I PROBABILITY AND RANDOM VARIABLES 9+3

Introduction to probability: Axioms of probability - Conditional probability - Total probability - Baye's theorem - Simple problems on Baye's theorem.

Random variables: Discrete and continuous random variables - Distribution function of random variable - Properties, probability mass function - Probability density function - Mathematical expectation - Properties- Moments - Moment generating functions and their properties.

UNIT II PROBABILITY DISTRIBUTIONS 9+3

Discrete distributions: Binomial - Poisson - Geometric distribution and their properties. **Continuous distributions**: Uniform - Exponential - Gamma - Normal distributions and their properties.

UNIT III TESTING OF HYPOTHESIS 9+3

Sampling distributions - Estimation of parameters - Statistical hypothesis - large sample test based on normal distribution for single mean and difference of means -small sample tests: t-test for mean - F- test Chi-square test for Goodness of fit and Independence of attributes.

UNIT IV DESIGN OF EXPERIMENTS 9+3

One way and two-way classifications - Completely Randomized Design - Randomized Block Design -Latin Square Design-22 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9+3

Control charts for measurements(X and R charts) - Control charts for attributes (p, c and np charts) - Tolerance limit-Acceptance sampling.

TOTAL: (45+15) PERIODS

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BoS (S&H) 14/10

OUTCOMES:

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

- Relate real life problems with concept of Probability and Random variables
- Apply the concept of probability distributions in solving engineering problems
- Applying the concept of testing of hypothesis for small and large samples in real life problems
- Analyzing the basic concepts of classifications of design of experiments
- Creating the notion of sampling distributions and in the field of statistical quality control used in engineering and management problems

TEXT BOOKS:

1. Johnson R.A., Miller, I and Freund J, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Richard A. Johnson., "Probability and Statistics for Engineers", Pearson Education, 8th Edition, 2019.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8th Edition, 2021.
2. S.C.Gupta, and V.K.Kapoor, "Fundamental of Mathematical Statistics ", S Chand Publications Reprint, 2013.
3. Spiegel Schiller "Probability and Statistics" Tata McGraw-Hill Publishing Company Limited, New Delhi. 3rd Edition, 2018.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	1	-	-	-	-	1	-	-	2
CO2	2	3	1	-	-	-	-	1	-	-	2
CO3	2	3	1	2	1	-	-	1	-	3	3
CO4	2	3	1	2	1	-	-	1	-	3	3
CO5	2	3	1	2	1	-	-	1	-	3	3

CHAIRMAN
BoS (S&H) 14/10

24BM401 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Develop fundamental idea about the biopotential and various electrodes used for measurement
- Identify the signal quality and find the suitable amplifier for further processing the signal.
- Compare and contrast the recording setup of ECG, EEG, EMG, EOG and ERG
- Inspect the different techniques used for the measurement of non-electrical parameters
- Explain the biochemical measurement technique required for diagnosis and treatment.

UNIT I BIOPOTENTIAL ELECTRODES 9

Origin of bio potential and its propagation, Electrode-electrolyte interface, Electrolyte-skin interface, skin contact impedance, Motion artifacts, polarization, Silver – Silver chloride electrode, Electrode theory, Biopotential electrodes - surface, needle and micro electrodes, Measurements with two electrodes.

UNIT II BIOSIGNAL AMPLIFIERS AND INTERFERENCE 9

General considerations for signal conditioners, preamplifier – biopotential amplifier, Instrumentation amplifier, Carrier amplifier, Chopper amplifier, Isolation amplifiers - Transformer and optical isolation. Power line interference, Right leg driven ECG amplifier.

UNIT III BIOSIGNAL RECORDING SYSTEMS 9

Bio signals characteristics - frequency and amplitude ranges, Basic recording system, ECG – Recording set up, Einthoven's triangle, Standard 12 lead system, Vector cardiograph, EEG – Recording set up, 10-20 electrode system, EMG - Recording setup, EOG - Recording system, Recording of ERG.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measuring methods. Blood pressure: Indirect methods - Auscultatory methods, Oscillometric method, Direct methods: H_2O Manometers, Cardiac output measurement - Indicator dilution, Thermal dilution and dye dilution methods, Blood flow - Electromagnetic and Ultrasonic blood flow measurement.

UNIT V BIOCHEMICAL MEASUREMENT AND BIOSENSORS 9

Biochemical sensors - pH, pO_2 and pCO_2, Colorimeter, Spectrophotometer, Flame photometer, Selective- ion electrodes based electrolytes analyzer, Blood gas analyzers, Blood cell counter, Auto analyzer.

TOTAL: 45 PERIODS

CHAIRMAN
BoS 04/07/25

OUTCOMES:

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

- Analyze and address the challenges in measuring biopotentials using various types of electrodes
- Assess the necessity of signal conditioning circuits and choose the appropriate amplifier for signal processing
- Contrast and appreciate the differences in the recording set up required for capturing various bio signals.
- Measure the non-electrical parameters and match with the normal values to determine the health of human
- Determine the biochemical parameters by means of suitable techniques for measuring and counting.

TEXT BOOK:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2nd Edition, Prentice Hall of India, New Delhi, 2015.
2. Khandpur R S. "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2014.

REFERENCES:

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, 2004.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	3	3	–	2	–	–	–	–	3	2
CO2	3	3	–	3	3	–	–	–	–	–	–	3	3
CO3	3	2	2	–	3	–	1	–	–	–	–	3	3
CO4	2	2	–	2	2	2	–	–	–	–	1	2	3
CO5	3	2	2	3	3	–	–	–	–	–	–	3	3

CHAIRMAN
BoS

24BM402 **SENSORS AND MEASUREMENTS** L T P C
3 0 2 4

COURSE OBJECTIVES:

- Develop practical skills to calibrate instruments and analyze transducer performance using standardized techniques.
- Interpret transducer performance and assess precision measurement techniques
- Apply analysis techniques to assess photo transducers and standard signals.
- Design a measurement setup using appropriate signal conditioning tools
- Interpret sensor technologies and data methods in medical electronic systems.

UNIT I FUNDAMENTALS OF MEASUREMENTS 9

Measurement System – Functional elements of an instrument - Classification and Characteristics of Transducers - Static and Dynamic - Standards and calibration – Errors in Measurements and their statistical analysis - methods of error analysis, - uncertainty analysis.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 9

Linear Potentiometers - LVDT - Ultrasonic Sensors - Capacitive Sensors - Strain Gauge. Capacitive transducer - Various arrangements, Piezoelectric transducer, Inductive transducer, Thermistor used for Cardiac output measurement and Nasal air flow measurement, Thermocouple, Radiation thermography, Pyrometer, Infrared temperature probe, Optical Pyrometer and Applications.

UNIT III PHOTO ELECTRIC AND PIEZO ELECTRIC SENSORS 9

Phototube, 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 – Acoustic sensors.

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 and dynamometer type instruments - Digital voltmeter – Multi meter.

UNIT V RECORDING DEVICES AND BIOSENSORS 9

CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder. Biosensors: transduction mechanism in a biosensor and Classification – Electronic nose, Blood Glucose sensors. Biosensors in medicine and health care - Biosensors for agriculture and Environment monitoring.

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PRACTICALS: **30**

1. Calibration of voltmeter and ammeter using shunt type Potentiometer.
2. Characteristics of LVDT.
3. Characteristics of Temperature Transducer – Thermistor and RTD.
4. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone bridge.
5. Characteristics of Photo electronic Transducers - LDR, Photo Diode, Photo Transistor.
6. Characteristics of Standard Signals (Step, Ramp, Impulse, Square, Triangular).
7. Characteristics of CRO & DSO.
8. Study of Electronic nose.

TOTAL:75 (45+30) PERIODS

COURSE OUTCOMES:

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

- Apply calibration standards to assess instrument performance using potentiometer and LVDT techniques.
- Evaluate temperature transducer characteristics and apply precision bridge techniques for resistance measurement.
- Demonstrate evaluation of photo transducer characteristics and standard signal analysis.
- Interpret signal conditioning and measurement techniques using bridges, digital instruments, CRO, and DSO.
- Analyze sensor technologies and data methods in electronic systems for medical applications.

TEXT BOOKS:

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.
3. Ernest O Doebelin and Dhanesh N Manik, "Measurement systems, Application and design", 6th edition, McGraw-Hill, 2012.

REFERENCES:

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

CHAIRMAN
BoS

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	3	–	–	2	2	1	2	2	2
CO2	3	3	2	2	3	–	–	2	1	1	2	2	3
CO3	3	2	2	2	3	–	–	2	1	1	2	2	3
CO4	3	2	2	2	3	–	–	2	2	1	2	2	3
CO5	3	2	2	3	3	–	2	2	2	1	3	3	3

CHAIRMAN
BoS 03/07/25

24BM403	BIOCONTROL SYSTEMS	L T P C 3 0 0 3

OBJECTIVES

The student should be made to:

- Develop the ability to derive mathematical models (transfer functions) for various physical systems.
- Apply various methods for analyzing the time response of the systems
- Familiarize students with graphical tools for assessing the frequency response.
- Examine specific examples of physiological control, such as the lung mechanism and skeletal muscle, from a systems perspective.
- Explain the mathematical modeling of various physiological systems.

UNIT I CONTROL SYSTEM MODELING **9**

Control System –Introduction, Open loop and Closed loop systems, Differential equation – Transfer function, Modeling of Mechanical Translational and Rotational Systems, Electrical systems, Analogous system, Block diagram reduction Techniques, Signal flow graph.

UNIT II TIME RESPONSE ANALYSIS **9**

Time response, Time response of First Order Systems and Second Order Systems, Time domain specifications, Steady state error, Generalized error co–efficient, Routh- Hurwitz criteria of stability, Root locus technique

UNIT III FREQUENCY RESPONSE ANALYSIS **9**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles.

UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS **9**

Physiological Control Systems: A simple Example - Difference between engineering and physiological control system-Generalized System Properties-Models with combinations of system elements- -Linear Models of Physiological Systems- Lung Mechanism , Skeletal Muscle Distributed parameter versus lumped parameter models.

UNIT V BIOLOGICAL CONTROL SYSTEM ANALYSIS **9**

Determination of steady state operating point-Study of regulation of cardiac output, Study of Regulation of Glucose Insulin – Study of Chemical Regulation of Ventilation- Stability analysis of Pupillary light reflex.

TOTAL: 45 PERIODS

CHAIRMAN
BoS 04/07/25

OUTCOMES:

At the end of the course, students will be able to,

- Apply mathematical modeling to various systems using block diagrams and signal flow graphs.
- Determine the time response of various systems and discuss the concept of system stability
- Analyze the frequency response characteristics of various systems using different charts.
- Construct and interpret the basic physiological systems model and compare it with engineering systems.
- Comprehend the application aspects of various response analysis in biological systems.

TEXT BOOKS:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 7thEdition, 2021.
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2nd Edition, 2018

REFERENCES:

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 10th Edition, 2017.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", 3rd Edition, Academic Press, 2012.
3. Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 13th Edition, 2017.
4.S. Salivahanan, R. Rengaraj, G. R. Venkatakrishnan, "Control Systems Engineering" 1st Edition, Pearson Education, 2016.
5. A. Anand Kumar, "Control Systems", PHI Learning Private Limited, 2nd Edition, 2014.

Mapping of COs with POs and PSOs

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

CHAIRMAN
BoS

24EC406 ANALOG AND DIGITAL INTEGRATED CIRCUITS

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Develop the ability to design and evaluate operational amplifier circuits for Analog signal conditioning.
- Apply the principles of data conversion and special function ICs for accurate signal acquisition and processing.
- Implement combinational logic using Boolean algebra and simplification rules.
- Construct fundamental combinational circuits for digital system design.
- Investigate the design and behavior of sequential circuits in digital systems.

UNIT I DESGIN AND APPLICATIONS OF OPERATIONAL AMPLIFIER 9

Operational amplifier –ideal characteristics, voltage follower, Inverting Amplifiers, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator.

UNIT II DATA CONVERSION TECHNIQUES AND SPECIAL FUNCTION ICs 9

Sample and hold circuit, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Monolithic PLL IC565, IC 555 Timer – Function Description.

UNIT III DIGITAL LOGIC AND MINIMIZATION TECHNIQUES 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map.

UNIT IV LOGIC DESIGN WITH COMBINATIONAL CIRCUITS 9

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, Multiplexer and Demultiplexer.

UNIT V ANALYSIS AND DESIGN OF SEQUENTIAL LOGIC 9

Flip flops – SR, JK, T, D, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

OUTCOMES:

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

- Design and analyze operational amplifier circuits for signal conditioning applications.
- Analyze and evaluate data conversion circuits and special function ICs
- Develop basic digital circuits using number systems, Boolean expressions, and logic simplification.
- Design and build fundamental combinational logic circuits to solve digital problems
- Demonstrate sequential circuit functionality using flip-flops, counters, and shift registers for digital system design.

TOTAL:45 PERIODS

CHAIRMAN
BoS/ECE 07/07/25

TEXT BOOKS

1. D. Roy Choudhury, Shali B. Jain "Linear Integrated Circuits", Fourth Edition
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Mc Graw Hill Education, 3rd Edition, 2017
3. M. Morris Mano and Michael D.Ciletti, "Digital Design", Pearson, 5th Edition, 2013
4. 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. S Salivahanan and V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education, 3rd Edition, 2018.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	–	–	–	–	–	2	3	2
CO2	3	3	2	2	3	–	–	–	–	–	2	2	3
CO3	3	2	2	–	3	–	–	–	–	–	2	–	–
CO4	3	3	3	–	3	–	–	2	2	–	2	–	–
CO5	3	2	3	–	3	–	–	2	2	–	2	–	2

CHAIRMAN
BoS/ECE

24MC003	CONSTITUTION OF INDIA (Common to All Branches)	L T P C 2 0 0 0

OBJECTIVES:

The students should be made to:

- Apply the understanding of fundamental rights and duties to real life situations and legal case studies.
- Illustrate the roles and responsibilities parliamentary framework.
- Analyze the general structure of the state executive roles in the state level.
- Investigate the powers and judicial responsibilities of the higher Judiciary.
- Judge the strength and limitations of India's federal power structure in practice.

UNIT 1 INTRODUCTION **6**

Historical background - Government of India act - Indian councils act - Making of the constitution - Philosophy of the Indian constitution - Preamble.

UNIT II GOVERNMENT OF THE UNION **6**

Powers and Functions of President and Prime Minister - Council of Ministers – President in relation to his council - Legislature structure and functions of Lok Sabha and Rajya Sabha - Speaker.

UNIT III GOVERNMENTS OF THE STATES AND LOCAL GOVERNMENT **6**

The state executive: General structure - Governor - Council of ministers - State legislature. Local government - Panchayat - Municipality - Power authority and responsibilities municipalities.

UNIT IV THE JUDICATURE **6**

Organization and Composition of Judiciary – Constitution – Appointment - Qualifications - Powers and functions of the supreme court– High courts – Control over subordinate courts.

UNIT V THE FEDERAL SYSTEM **6**

Distribution of financial powers: Need, principles-Underlying distribution of tax revenues-Distribution of legislative power – Interstate relation - Emergency provisions.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Distinguish and apply constitutional principles and democratic values of the Indian constitution.
- Emphasize on the powers and interactions of the president, prime ministers in the parliamentary structure.
- Evaluate the structure, powers and functions of state and local governance.
- Demonstrate the Indian judiciary, structure and functions of courts.
- Explore the financial, legislative provisions of Indian federation.

CHAIRMAN
BoS (S&H) 20/6/25

TEXT BOOKS:

1. Basu D.D, "Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES:

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, New Delhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.
3. The Constitution of India, 1950 (Bare Act), Government Publication.
4. Jain M P, Indian Constitution Law, 7th Edition. Lexis Nexis, 2014.
5. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	-	-	-	2
CO2	-	-	-	-	-	3	3	2	2	2	3
CO3	-	-	-	-	-	3	3	2	2	2	3
CO4	-	-	-	-	-	3	3	-	2	2	3
CO5	-	-	-	-	-	3	3	-	-	3	2

CHAIRMAN
BoS (S&H)

24BM405L BIOMEDICAL INSTRUMENTATION LABORATORY **L T P C**
0 0 2 1

OBJECTIVES:

The student should be made to:

- Apply bio-signal acquisition principles in designing amplification and filtering circuits
- Construct safe and reliable analog front-ends for physiological signal measurement.
- Develop customized circuit solutions for detecting and analyzing specific bioelectric events
- Demonstrate the use of transducers and instrumentation for measuring physiological and biochemical parameters
- Determine peripheral blood flow, pH and conductivity of the circulatory dynamics

LIST OF EXPERIMENTS:

1. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
2. Design of EMG amplifier.
3. Design a suitable circuit to detect QRS complex and measure heart rate.
4. Design of frontal EEG amplifier.
5. Design of EOG amplifier to detect eye blink.
6. Design a right leg driven ECG amplifier.
7. Design and study the characteristics of optical isolation amplifier.
8. Design a Multiplexer and Demultiplexer for any two bio signals.
9. Measurement of pulse-rate using Photo transducer.
10. Measurement of blood pressure using sphygmomanometer.
11. Measurement and recording of peripheral blood flow.
12. Measurement of pH and conductivity.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Design ECG and EMG amplifiers with appropriate filtering to eliminate artifacts and enhance signal quality.
- Construct and assess signal conditioning solutions for EEG, EOG, and safety-enhanced ECG
- Assess optical isolation and multiplexer/demultiplexer circuit designs for biosignal applications
- Apply appropriate biomedical instrumentation to measure and analyze pulse rate and blood pressure
- Conduct measurements and analyze data for peripheral blood flow, pH, and conductivity.

CHAIRMAN
BoS 04/07/25

Mapping of COs with POs and PSOs

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

CHAIRMAN
BoS

24EC407L ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

The student should be made to:

- Identify and select appropriate components for constructing Op-Amp circuits.
- Construct operational amplifier-based Schmitt trigger and instrumentation amplifier circuits according to design specifications.
- Determine how component values influence the output characteristics of the RC/LC and Multivibrator waveform generation circuits.
- Explain the fundamental principles of Boolean algebra and the operation of basic logic gates
- Construct and validate digital logic circuits by applying multiplexing and sequential counting techniques in combinational and sequential systems.

LIST OF EXPERIMENTS:

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Schmitt trigger using operational amplifier
4. Instrumentation amplifier using operational amplifier
5. RC and LC oscillators
6. Multivibrators using IC555 Timer
7. Study of logic gates, Half adder and Full adder
8. Encoder and BCD to 7 segment decoder
9. Multiplexer and demultiplexer using digital IC trainer Kit
10. Construction and verification of 4-bit ripple counter and Mod 10/Mod 12 Ripple counter

TOTAL: 30 PERIODS

OUTCOMES:

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

- Construct and analyze the operational characteristics of fundamental analog circuits,
- Analyze the functional characteristics of Schmitt and instrumentation amplifiers in signal processing.
- Examine and assess the behavior of RC/LC oscillators and 555 timers in waveform generation
- Apply digital logic principles to implement and evaluate combinational circuits
- Implement and verify multiplexing and ripple counting techniques using Digital ICs to demonstrate data routing and sequential logic operations.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	–	–	–	–	–	2	2	2
CO2	3	2	2	2	3	–	–	–	–	–	2	3	3
CO3	3	2	2	2	3	–	–	–	–	–	2	2	2
CO4	3	2	3	–	3	–	–	2	2	–	2	–	–
CO5	3	2	3	–	3	–	–	2	2	–	2	–	–

CHAIRMAN
BoS/ECE 07/07/25

24EEC401L	LIFE SKILLS AND PERSONALITY DEVELOPMENT (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The students should be made to:

- Create self- confident among the students by the training
- Develop good personality for mature outlook in different circumstances
- Encourage effective presentation skills
- Dramatize role play by assigning the best role
- Enhance team building and time management skills

UNIT I CAREER PLANNING **6**

Introduction - Benefits of Career Planning - Expectation and Development - Guidelines for choosing a Career - Future planning - Evaluation of planning.

UNIT II ATTITUDE **6**

Introduction - Rightness of Attitude and behaviour - Formation of Attitudes - Evolving Behaviour of a person - Creating right attitudes - Approaches of Challenges - Lessons from Attitude.

UNIT III ROLE PLAYING **6**

Introduction - settings of role plays - Principles and Purpose - importance of communication in role plays - Arrangement of points and character - Extempore Talk - Debates - Emotional Intelligence.

UNIT IV TEAM BUILDING **6**

Purpose of Creating Team - Exploring Team roles and Processes - Importance of Building and Developing Strong Team - Leadership Qualities - Success of Team Building.

UNIT V TIME MANAGEMENT **6**

Value of time - Concept and applications of time management - Causes for wasting of time - Methods of Time Management - Diagnosing Time Management - Planning for presentation - To - do - list - Prioritizing work

TOTAL: 30 PERIODS

OUTCOMES:

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

- Improve the leadership skills by identifying the strengths of a team
- Learn to lead a team on a project in an organization
- Helps students to perform on a distinct role and learn to face the challenges
- Build a strong team to achieve their goals with the right choice of people
- Develop the time management skills to achieve success

CHAIRMAN 14/10
BoS (S&H)

TEXT BOOKS:

1. "Soft Skills", Career Development Centre, Green Pearl Publications, 2015.

REFERENCES:

1. Thomas A Harris, "IAm Ok, You Are Ok", Harper and Row, New York 1972.
2. Daniel Coleman, "Emotional Intelligence", Bantam Book, 2006.
3. Nira Konar, "Communication Skills for Professionals", Eastern Economy Edition, 2010.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1	2	2	1	1	2	3	1	3
CO2	1	2	1	2	2	1	1	2	3	1	3
CO3	1	2	1	2	2	1	1	3	3	1	3
CO4	1	2	1	2	2	1	1	3	3	1	3
CO5	1	2	1	2	2	1	1	3	3	1	3

CHAIRMAN
BoS (S&H) 14/10

24BM501	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the principles and applications of cardiac diagnostic and therapeutic equipment
- Explain the functioning and clinical relevance of neurological instrumentation
- Describe muscular measurement systems and electrotherapy devices used in rehabilitation and diagnostics
- Analyze respiratory measurement systems and ventilator technologies
- Evaluate sensory measurement instruments and oximetry techniques for physiological monitoring

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Cardiac monitor, Arrhythmia monitor, Holter Monitor, Phonocardiography, ECG machine maintenance, ECG faults and troubleshooting, Cardiac Pacemaker-Internal and External Pacemaker - Batteries, AC and DC Defibrillator - Internal and External, cardiac catheterization, Heart lung machine.

UNIT II NEUROLOGICAL EQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential - Visual, Auditory and Somatosensory, MEG (Magneto Encephalograph), EEG Bio Feedback Instrumentation, EEG system maintenance and troubleshooting, EEG Telemetry.

UNIT III MUSCULAR MEASUREMENTS AND ELECTROTHERAPY EQUIPMENT 9

Recording and analysis of EMG, Muscle stimulators, Nerve stimulators, Nerve conduction velocity measurement, short wave and microwave diathermy, ultrasonic therapy unit, electro-diagnostic therapeutic stimulator. TENS, spinal cord stimulator and bladder stimulator.

UNIT IV RESPIRATORY MEASUREMENT SYSTEM 9

Lung Volume and Vital capacity, Instrumentation for measuring the mechanics of breathing – Spirometer, Measurements of residual volume, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Airway resistance measurement, Pneumotachometer, Inhalators, Types of Ventilators - Pressure, Volume and Time controlled, Humidifiers, Nebulizers and Aspirators.

UNIT V SENSORY MEASUREMENT AND OXIMETERS 9

Psychophysiological Measurements -polygraph, Basal Skin Resistance (BSR), Galvanic Skin Resistance (GSR). Instrumentation for Sensory measurements – Audiometer - Pure tone, Speech, Eye Tonometer, Applanation Tonometer. Oximeters – in vitro oximetry and in vivo oximetry.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the function and maintenance of cardiac equipment.
- Explain the clinical use of EEG and neurological instruments
- Apply electrotherapy techniques using muscular measurement devices
- Analyze respiratory systems and ventilator operations
- Evaluate sensory instruments and oximeters for diagnostic accuracy

Chairman
Bos/BME

TEXT BOOKS:

1. John G Webster, "Medical Instrumentation Application and Design", Fourth 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. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003.

2. Geddes LA and Baker LE, "Principles of Applied Biomedical Instrumentation", Fourth Edition, A Wiley-Interscience Publication, 2008.

3. Lelie Cromwell, "Biomedical Instrumentation and Measurement, Pearson Education, New Delhi, 2007

4. Antony YK Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illionois, USA, 2008.

5. Brown B H, Smallwood RH, Barber DC, Lawford PV and Hose D R, "Medical Physics and Biomedical Engineering", Second Edition, IOP Publishers, 2001.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	2	1	-	-	1	-	1
CO2	3	2	1	-	2	1	-	-	1	-	1
CO3	3	2	3	1	3	2	-	-	1	-	2
CO4	3	3	2	3	3	2	-	-	1	1	2
CO5	3	3	2	3	3	2	-	-	1	1	2

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24BM502	BIOMATERIALS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Classify various biomaterials based on their composition, properties, and biomedical applications.
- Assess the metallic and ceramic biomaterials for composition, function, and biomedical relevance.
- Analyze biomaterials and textiles using polymer science for healthcare applications
- Evaluate biocompatibility and sterilization of biomedical devices using advanced biological testing
- Design biomaterial systems for biomedical use by integrating material science and clinical needs

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, nanostructured 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 TESTING OF BIOMATERIALS 9

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and In-vivo testing; Sterilization of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

UNIT V APPLICATIONS OF BIOMATERIALS 9

Cardiovascular Applications, Dental implants, Adhesives and Sealants, Ophthalmologic Applications, Orthopedic Applications, Drug Delivery System, Sutures, Bioelectrodes, Biomedical Sensors and Biosensors.

TOTAL:45 PERIODS

OUTCOMES:

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

- Analyze the properties, classifications, and their performance in biomedical applications.
- Design metallic and ceramic biomaterials for biomedical use based on structure and biocompatibility.
- Apply advanced biomaterial and textile technologies to solve biomedical challenges
- Analyze biocompatibility and testing protocols for effective biomedical implants
- Evaluate biomaterial solutions for diverse clinical applications of biomaterials

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TEXTBOOKS:

1. Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. Bronzino, J. D. (2000). The Biomedical Engineering Handbook. Germany: CRC Press
3. JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003

REFERENCES:

1. Sreeram Ramakrishna, Murugan Ramalingam, 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. "Implant biomaterials: 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.

Mapping of COs with POs and PSOs

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

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BoS/BME

BME

24BM503	BIO-SIGNAL PROCESSING	L T P C 3 0 2 4

COURSE OBJECTIVES:

- Analyze signals and systems by applying convolution, sampling, and quantization to assess signal integrity and system behavior.
- Apply signal processing and statistical learning models to real-world biomedical signals.
- Develop understanding of DFT, convolution techniques, and FFT algorithms for efficient signal processing.
- Construct digital filters by employing FIR and IIR design methods for effective signal processing applications.
- Examine DSP architectures and the TMS320C5X processor and **outline** their biomedical applications

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, spectral density, sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Introduction to Biosignal Classification, Statistical signal classification, linear discriminant function, Feature selection and ordering, Back propagation neural network-based classification. Application in Normal versus Ectopic ECG beats.

UNIT III DISCRETE FOURIER TRANSFORM 9

DFT and its properties – Direct Computation of DFT - Linear Convolution - Circular Convolution, Overlap-add and overlap-save methods. FFT - Decimation in Time Algorithm, Decimation in Frequency Algorithm.

UNIT IV FIR AND IIR DIGITAL FILTERS 9

FIR Filters: Design of linear phase FIR filters using Windows (Rectangular, Hamming and Hanning Window). **IIR Filters:** Design of digital IIR filters from analog filters – Bilinear transformation – Impulse Invariance technique – Butterworth and Chebyshev Filters.

UNIT V DIGITAL SIGNAL PROCESSOR AND ITS BIOMEDICAL APPLICATIONS 9

Introduction to DSP processors, Von Neumann, Harvard architecture – Architecture of TMS320C5X Digital Signal Processor – Addressing modes – Instruction set – Applications: Fetal ECG monitoring – DSP based closed loop anesthesia - Adaptive noise cancellation.

45 PERIODS

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LIST OF THE EXPERIMENTS:

SOFTWARE/SIMULATION:

1. Generation of Signals
2. Basic Operations on Signals
3. Linear Convolution
4. Circular Convolution
5. Computation of DFT
6. Design of FIR filters
7. Design of IIR filters

DSP PROCESSOR BASED IMPLEMENTATION:

1. Generation of Waveforms using DSP Processor
2. Basic operations using addressing modes

30 PERIODS
TOTAL:75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students be able to,

- Classify discrete-time systems by key properties and apply signal operations and convolution techniques to analyze system behavior.
- Analyze biosignals using statistical and neural network-based classification techniques to differentiate between normal and ectopic ECG beats
- Compute the DFT of discrete-time signals using both direct computation and FFT algorithms such as Decimation in Time and Decimation in Frequency.
- Implement FIR and IIR filter designs and validate their performance through performance testing and interpretation of filter characteristics
- Explain DSP architectures and the TMS320C5X processor, emphasizing their use in biomedical applications

TEXT BOOKS:

1. Allan V. Oppenheim, S. Wilsky and S.H. Nawab, "Signals and Systems", Pearson, Indian Reprint, Second Edition, 2015.
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, Second Edition, 2016.
3. Salivahanan S, Vallavaraj A, Gnanapriya C, "Digital Signal Processing", Second Edition, Tata McGraw Hill, 2016.

REFERENCES:

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2014.
2. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, Second Edition, 2007
3. M. H. Hayes, "Digital Signal Processing, Schaum's outlines", Tata McGraw Hill, Second Edition, 2011.

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BoS/BME

BME

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Mapping of COs with POs and PSOs

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

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24BM504	RADIOLOGICAL EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The student should be made to:

- Understand the generation of X-ray and its uses in Medical imaging
- Describe the principle of Computed Tomography.
- Know the techniques used for visualizing various sections of the body.
- Apply the principles of different radio diagnostic equipment in Imaging.
- Discuss the radiation therapy techniques and radiation safety

UNIT I **MEDICAL X-RAY EQUIPMENT** 9

Nature of X-rays, Production of X-Ray (Bremsstrahlung Spectrum). X- Ray Equipment (Block Diagram) – X-Ray Tube, collimator, Bucky Grid, power supply- Heel Effect-ray Generators-Factors Affecting X-Ray Emission. Digital Radiography- Computed radiography, CCD-Based, TFTs based and CMOS based Digital Radiography Systems. Fluoroscopy - X-ray Image Intensifier tubes – 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, CT Numbers, Imaging Artifacts, spiral CT scanning, ultra-fast CT scanners. CT Angiography - Image reconstruction techniques- back projection, iterative method and Fourier slice Theorem.

UNIT III **MAGNETIC RESONANCE IMAGING** 9

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave, rotation and precession. Induction of magnetic resonance signals – bulk Magnetization, Relaxation processes T1 and T2, Spin echo, MR image acquisition, Imaging parameters- TE, TR and image contrast. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), Gradient magnetic fields, Radio Frequency coils , shim coils, Electronic components, MR Artifacts. Fmri , MR Angiography

UNIT IV **NUCLEAR IMAGING SYSTEM** 9

Radioactivity- Radioactivity decay law -Half Life. Radio Isotopes- alpha, beta, and gamma radiations. Radiopharmaceuticals, Radionuclide Generators - Technetium-99m Radionuclide Generator. Internal Dosimetry. Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height Analyzer. Principles of SPECT and PET, PET/CT.

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UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Interaction of Radiation with Tissue-Molecular and Cellular Response to Radiation-Organ System Response to Radiation. Radiation therapy – linear accelerator, Tele gamma Machine. Recent Techniques in radiation therapy - Stereotaxic Radiosurgery, Stereotaxic Radiotherapy, Proton beam therapy, 3D CRT, IMRT, IGRT and Cyber knife. Radiation protection in medicine-radiation protection principles, ICRP, AERB.

TOTAL : 45 PERIODS

OUTCOMES :

At the end of the course the student will be able to:

- Describe the working principle of the X-ray machine and its application.
- Illustrate the principle computed tomography
- Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
- Demonstrate the applications of radionuclide imaging.
- Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

TEXT BOOK:

1. Steve Webb , " The Physics of Medical Imaging", Adam Hilger, Philadelpia, 1988.
2. Hendee R and Russell Ritenour " Medical Imaging Physics", Fourth Edition William Wiley – Liss, 2002.

REFERENCES:

1. Jerrold T.Bushberg, J.Anthony Seibert, Edwin M.Leidholdt,Jr, John M.Boone, 'The Essential Physics of Medical Imaging", Lippincott Williams and Wilkins, Third Edition, 2012.
2. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine", Springer, Third Edition 2006.
3. B.H.Brown, PV Lawford, RH Smallwood, DR Hose, DC Barber, "Medical physics and Biomedical Engineering", - CRC Press,1999.
4. Ragunathan P, "Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques", Paperback-Import-2007.

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Mapping of COs with POs and PSOs

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

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24BM505L DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY L T P C
0 0 2 1

OBJECTIVES:

The student should be made to:

- Understand the principles and clinical relevance of therapeutic and diagnostic biomedical equipment
- Explore the operation and applications of devices used in cardiopulmonary support and neurophysiological monitoring
- Interpret physiological signals using biotelemetry and biosignal acquisition systems
- Investigate therapeutic modalities such as diathermy and electrosurgical units in clinical settings.
- Analyze the biomedical signal patterns and patient safety parameters using modern instrumentation

LIST OF EXPERIMENTS

1. Study the working of Defibrillator and Pacemakers
2. Study of Heart lung machine model
3. Measurement of visually evoked potential
4. Measurement of various physiological signals using biotelemetry
5. Study of shortwave and ultrasonic diathermy
6. Measurement of Respiratory parameters using spirometry
7. Study of Ventilators and Ultrasound scanners
8. Galvanic Skin Resistance (GSR) measurement
9. Recording of Audiogram
10. Study of haemodialysis model
11. Analyze the working of ESU-cutting and coagulation modes
12. Analysis of ECG, EEG and EMG signals

TOTAL: 30 PERIODS

OUTCOMES:

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

- Demonstrate the working principles of defibrillators, pacemakers, ventilators, and heart-lung machines
- Analyze physiological signals such as ECG, EEG, EMG, GSR, and visually evoked potentials
- Evaluate respiratory and auditory parameters using spirometry and audiometry tools
- Apply biotelemetry systems for remote physiological monitoring and data interpretation
- Present technical findings through structured documentation and communicate device functionality to reviewers

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Mapping of COs with POs and PSOs

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

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24BM506L **MINI PROJECT – I** **L T P C**
0 0 2 1

OBJECTIVES:
The student should be made to:

- Identify problems and needs of society and industries.
- Divide complex problems into sub-modules.
- Identify relevant solutions through extensive literature survey.
- Prepare schematic diagrams for module design.
- Propose appropriate solutions using modern tools and techniques

The students must choose a topic and obtain approval from the Head of the Department. Students may do the Mini Project in a group. The maximum number of students in a group should not exceed 3. Every student group will be doing their project under the guidance of a faculty number. A comprehensive Mini Project report should be prepared by each group after completing the work to the satisfaction of the supervisor. The progress of the Mini Project will be evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The review committee will be a two-member Team. The Presence of Mini Project Supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 30 PERIODS

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

- Determine the required solutions for the problem
- Develop strategies to break complex problems into simpler modules
- Experiment and do analysis on the empirical data arrived
- Create documentation on the experimental output and prepare presentation
- Demonstrate the project ideas to the reviewers and continues to improve the performance

Mapping of COs with POs and PSOs

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

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24EEC501L PROFESSIONAL SKILLS AND CAREER DEVELOPMENT **L T P C**
(Common to All Branches) **0 0 2 1**

OBJECTIVES:

The student should be made to:

- Analyze problems effectively using critical thinking skills.
- Use language effectively with commitment and cooperation.
- Enrich creative thinking and presentation skills to meet industry requirements.
- Develop and enhance soft skills through individual and group activities.
- Acquire the right attitude and behavioral traits for personal and professional development.

UNIT I INTRODUCTION TO BASIC ARITHMETIC AND PERSONALITY TRAITS **6**

Aptitude - Numbers, Average, Percentage, Profit and loss, Picture pattern.
Soft skills - Personality development, Professional ethics, Perception insights, attitude and behavioral changes.

UNIT II CONCEPT OF PROPORTIONALITY & INTERPERSONAL SKILLS **6**

Aptitude - Time and work, Pipes and cisterns, Series completion, Critical reasoning.
Soft skills - Developing self - esteem, Significance of interpersonal behaviour and interpersonal relationships.

UNIT III AN APPROACH TO COGNITIVE APTITUDE AND LEADERSHIP SKILLS **6**

Aptitude - Time, speed and distance, Boats and streams, Races and games, Syllogism.
Soft skills - Leadership skills - Characteristics and importance of leadership, Roles and responsibilities of a good Leader

UNIT IV CONTEMPORARY APTITUDE AND SITUATIONAL RESPONSES **6**

Aptitude - Crypt arithmetic, Ranking, Logarithms, Cubes, Analogy.
Soft skills - Decision making - Processes and challenges, Creative and Critical thinking.

UNIT V NON-VERBAL REASONONG AND INFLUENCING OTHERS **6**

Aptitude - Clocks, Non - verbal reasoning, Permutation, Classifications.
Soft skills - Presentation skills - Make use of visual aids with modern tools, Insights on persistence and perseverance.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Ability to solve both analytical and logical problems in an effective manner
- Practice to organize and convey the information in such an optimistic way.
- Deliver a professional and constructive presentation
- Recognize explicit assumptions and their consequences
- Access the needed information effectively and efficiently.

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TEXT BOOKS:

1. Aggarwal R S, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand Publishing New Delhi, Revised Edition Oct 2024.
2. Agna Fernandez, "Generic Skills for Employability", Cambridge Publisher, Revised Edition, 2023.

REFERENCES:

1. Dr. Soma Mahesh Kumar, Soft Skills: "Enhancing Personal and Professional Success", McGraw Hill Education; First Edition, 2023
2. Aashish Arora, "Quanta Quantitative Aptitude" Kiran Institute of Career Excellence Pvt. Ltd, April 2022.

Useful Weblinks:

1. https://www.bbc.co.uk/learningenglish/
2. https://www.cambridgeenglish.org/test-your-english/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	2	3	1	1	1	3	2	1	2
CO2	2	1	1	1	1	2	2	2	2	1	2
CO3	2	3	2	2	2	3	2	3	3	1	2
CO4	2	3	2	3	3	2	1	3	2	3	2
CO5	1	1	2	2	3	1	2	3	3	1	2

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BoS (S&H)

24BM601	MEDICAL IMAGE PROCESSING	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Identify the fundamentals of digital and medical imaging, including image types, resolution, sampling, quantization, and healthcare applications.
- Investigate enhancement and noise reduction techniques in medical imaging using spatial and frequency domain methods.
- Examine image degradation models and restoration techniques to study blur identification, inverse filtering, and super-resolution methods
- Distinguish segmentation methods and feature extraction techniques to study edges, regions, clustering, and texture in medical images.
- Investigate medical image analysis techniques and emerging applications, including CAD systems, tissue detection, and AI-based methods.

UNIT I FUNDAMENTALS OF DIGITAL AND MEDICAL IMAGING **9**

Introduction to Images and Digital images – Types of Images: Binary, Grayscale and Colour Images – Image Resolution and Aspect Ratio – Components of Digital Image Processing System – Vision Fundamentals – Sampling and Quantization – Applications of Digital Image Processing in Healthcare – Overview of Medical Imaging Modalities: Computed Tomography (CT), Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI) and Ultrasound imaging.

UNIT II IMAGE ENHANCEMENT AND NOISE REDUCTION **9**

Problems associated with Medical Images – Sources and Types of Noise in Medical Images – Spatial Domain Enhancement Techniques: Contrast Stretching and Histogram Equalization – Spatial Filtering Methods: Low Pass Filter, High Pass Filter and Median Filter – Frequency Domain Enhancement Techniques – Fourier Transform in Image Processing – Frequency Domain Filters – Convolution Theorem - Smoothing Domain Filters

UNIT III IMAGE RESTORATION **9**

Image Degradation Models – Continuous and Discrete Degradation Functions – Estimation of Degradation Functions – Blur Models: Motion Blur and Defocus Blur – Image Restoration Techniques: Inverse Filtering, Least Square Filtering– Blur Identification Methods – Super-Resolution Methods.

UNIT IV IMAGE SEGMENTATION AND FEATURE EXTRACTION **9**

Fundamentals of Image Segmentation – Edge Detection Methods – Thresholding Techniques – Region - Based Segmentation Methods: Region Growing, Split and Merge Techniques – Clustering based Segmentation using K-means – Feature Extraction Techniques: Shape Features and Texture Features.

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UNIT V MEDICAL IMAGE ANALYSIS AND APPLICATIONS 9

Medical Image Analysis Techniques – Computer Aided Diagnosis (CAD) systems – Classification Methods in Medical Imaging – Breast Tissue Detection – Analysis of Tissue Structure –Recent Trends in Medical Image Processing: Artificial Intelligence and Deep Learning Applications.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Sinha, G. R., and Bhagwati Charan Patel. Medical image processing. PHI Learning Pvt. Ltd., 2014

REFERENCE BOOKS

1. Gopi, E.S. Digital Signal Processing for Medical Imaging Using MATLAB. Springer Science & amp; Business Media, 2013.
2. Gopi, E.S. Digital Signal Processing for Medical Imaging Using MATLAB Hardcover-Import, 14 September 2012.
3. Gonzalez, Rafael C. Digital image processing. Pearson education India, 2009
4. Dhawan, Atam P. Medical image analysis. John Wiley & Sons, 2011.
5. Suetens, Paul. Fundamentals of medical imaging. Cambridge university press, 2017.
6. Deserno, Thomas Martin. "Biomedical Image Processing (Biological and Medical Physics, Biomedical Engineering)." (2001).

OUTCOMES:

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

- Interpret digital imaging principles and medical imaging modalities such as CT, MRI, and ultrasound.
- Apply image processing techniques to improve medical image quality through filtering, transformation, and noise reduction.
- Develop restoration approaches to reconstruct degraded medical images using filtering and resolution enhancement methods.
- Construct segmentation and feature extraction approaches for analyzing medical images.
- Demonstrate proficiency in medical image analysis by applying classification methods, tissue structure evaluation, and AI-driven approaches.

Mapping of COs with Pos and PSOs

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

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24EC401 MICROPROCESSORS AND MICROCONTROLLERS (COMMON TO ECE, EEE & BME) **L T P C 3 0 0 3**

OBJECTIVES:

The Student should be made to:

- Understand the evolution and features of the 8086 microprocessor.
- Analyse the role of various instruction sets in execution control.
- Design the semiconductor memory is interfaced with the 8086 microprocessor.
- Develop assembly language programs for data transfer, arithmetic, and logical operations in 8051
- Analysis the impact of waveform generation techniques on hardware control.

UNIT I ARCHITECTURE SIGNALS AND FEATURES **9**

Introduction: History of computers, Block diagram of a microcomputer, Intel 80x86 evolutions, Features of 8086 microprocessor, register organization of 8086,Architecture of 8086, Instruction queue and pipelining, Segmentation of memory used with 8086, Methods of generating physical address in 8086, Pin signals of 8086, Common signals, Minimum mode signals with timing diagram, Maximum mode signals with timing diagram

UNIT II PROGRAMMING IN 8086 **9**

Addressing modes of 8086, Data Transfer Instructions, Data Conversion Instructions, Arithmetic Instructions, Logical instructions and Processor control instructions, String instructions, Branch Instructions Example programs, Assembly Language Programming of 8086, Stack structure, Interrupt structure

UNIT III 8086 INTERFACING WITH MEMORY AND PROGRAMMABLE DEVICES **9**

Semiconductor memory interfacing, Dynamic RAM interfacing,Interfacing program memory and data Memory with 8086, Programmable Peripheral Interface 8255, ADC with programming,DAC with programming,8254 with programming,8259 with programming, 8279 with programming, 8251 USART, 8257, Stepper Motor interfacing

UNIT IV 8051 ARCHITECTURE AND ASSEMBLY PROGRAMMING **9**

Differences between microprocessor and microcontroller, 8-bit microcontrollers, and feature of 8051 microcontroller, Architecture of 8051, Signal descriptions of 8051, Register set of 8051, Operational features of 8051, Memory and I/O addressing, Interrupts and Stack, Addressing modes, Arithmetic and Logical Instructions, Data Transfer Instructions, Boolean Variable Instructions and Branch Instructions, Assembly Language Programming

UNIT V 8051 INTERACING AND EMBEDDED PRGOGRAMMING **9**

Parallel ports, Timer, Interrupts, serial port, Push-button,Matrix keypad, LED, 7- segment, LCD displays, DAC, ADC, DC motor, Stepper motor, Servo motor

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Understand the architecture and features of the 8086 microprocessor
- Develop assembly language programs using 8086 instructions
- Interface 8086 with memory and peripheral devices
- Demonstrate the architecture and programming of the 8051 microcontroller
- Interface and control waveform generators and special function ICs

TEXT BOOKS:

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 - Microcontroller and Embedded systems", 7th Edition, Pearson Education, 2011.
2. Doughlas.V.Hall, "Microprocessor and Interfacing: Programming and Hardware", 3rd edition, McGraw Hill, 2015
3. Kenneth. J. Ayala, "8051 Microcontroller Architecture, Programming and Applications",3rd edition, Thomson, 2007

REFERENCES:

1. Subrata Ghoshal "8051 Microcontroller Internals Instructions, Programming and Interfacing",2nd edition Pearson, 2010
2. Yu-cheng Liu, Glenn A.Gibson, "Microcomputer systems: The 8086/8088 family-Architecture, programming and design",2nd edition, Prentice Hall of India, 2007

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	1	-
CO3	3	3	3	2	3	1	-	-	1	2	-
CO4	3	2	2	1	2	-	-	-	-	-	-
CO5	3	2	3	2	3	1	-	-	2	2	1

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29/9/25

24EC404L MICROPROCESSOR AND MICROCONTROLLER LABORATORY
(COMMON TO ECE, EEE & BME)

L	T	P	C
0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Simulate and analyze 8086 programs using MASM
- Implement interfacing of peripheral devices with 8086
- Design and develop DAC, ADC, DC motor in 8086
- Design and implement assembly programming in 8051 for general-purpose computing
- Develop embedded C programs to interface peripheral devices with 8051/89s52

LIST OF THE EXPERIMENTS

1. Simulation of 8086 using MASM Software (Data Transfer Instructions, Data Conversion Instructions, Arithmetic Instructions, Logical instructions and Processor control instructions, String instructions)
2. Interfacing 8255 with 8086
3. Interfacing 8251 with 8086
4. Interfacing 8279 with 8086
5. Interfacing DAC & ADC with 8086.
6. Interfacing DC motor & stepper motor with 8086
7. General Purpose Programming in 8051(Arithmetic and Logical Instructions, Data Transfer Instructions, Boolean Variable Instructions)

Embedded C Programming

8. Interfacing LED, 7- segment with 8051/ 89s52
9. Interfacing input devices Matrix Keypad in 8051/89s52
10. Interfacing DC motor & stepper motor with 8051/ 89s52
11. Interfacing DAC & ADC with 8051/89s52
12. Programming Timer & Counter in 8051/89s52
13. Programming Serial Communication in 8051/89s52

TOTAL: 45 PERIODS

OUTCOME:

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

- Demonstrate the simulation of 8086 microprocessor instructions using MASM software and analyze its data processing capabilities.
- Interface and configure peripheral devices (8255, 8251, 8279, DAC, ADC, DC motor, and stepper motor) with the 8086 microprocessor and evaluate their performance.
- Develop and implement general-purpose programs using 8051 microcontroller instructions and Embedded C programming for various applications.
- Design and test interfacing of various input/output devices (LED, 7-segment display, matrix keypad, motors, ADC, DAC) with 8051/89s52 microcontrollers
- Analyze and implement timer, counter and serial communication programming in the 8051/89s52 microcontroller for real-time embedded applications.

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MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	2	3	-	-	-	-	-	1
CO2	3	3	2	2	3	1	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-
CO4	3	2	3	2	3	-	-	-	-	-	1
CO5	3	3	2	2	3	1	-	-	-	-	1

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. 8086 microprocessor trainer -(10 Nos)
2. 8051 microcontroller trainer - (10 Nos)
3. 80s52 Micro controller trainer-(10 Nos)
4. Interface with 8251.8255 &8279 kits - (Each 2 Nos)
5. DAC \ ADC Interface - (2 Nos)
6. Stepper motor Interface- (2 Nos)
7. Standalone desktops PC - (15 Nos)
8. MASM Simulation Software: (any public domain or commercial software)

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24BM602L **MEDICAL IMAGE PROCESSING LABORATORY** **L T P C**
0 0 3 1.5

OBJECTIVES:

The student should be made to:

- Appreciate digital image representation, sampling, quantization, and enhancement methods for medical image processing.
- Explore spatial filtering, noise reduction, and restoration methods to study medical image quality improvement.
- Differentiate edge detection, segmentation, and feature extraction techniques for analyzing medical images.
- Characterize morphological operations, frequency domain filtering, and wavelet transforms for medical image enhancement and compression.
- Analyze compression, registration, and visualization techniques to study efficient storage, alignment, and 3D rendering of medical images.

LIST OF THE EXPERIMENTS-

1. Determination of digital image representation and conversion between color, grayscale, and binary images.
2. Implementation of image sampling and quantization – Analysis of resolution and bit depth effects.
3. Histogram processing – Plotting, Contrast stretching, and Histogram equalization.
4. Application of Spatial Domain Filters – Low-Pass, High-Pass, and Median Filters.
5. Addition and Removal of Noise in Medical Images using appropriate Filtering Techniques.
6. Image Degradation and Restoration using Inverse Filtering and Wiener Filtering Methods.
7. Edge Detection Techniques – Sobel, Prewitt, and Canny Operators.
8. Image Segmentation using Thresholding, Region Growing, and K-means Clustering Methods.
9. Feature Extraction from Medical Images – Shape, Texture and Statistical Descriptors.
10. Morphological Image Processing – Erosion, Dilation, Opening and Closing Operations.
11. Frequency Domain Filtering – Fourier Transform - Based Low - Pass, High - Pass and Band - Pass Filters.
12. Wavelet Transforms in Medical Imaging – Multi - Resolution Analysis for Denoising and Compression.
13. Image Compression Techniques – Implementation of Lossless and Lossy Methods (JPEG, PNG, Run-Length Encoding).
14. Registration of Medical Images – Alignment of Multimodal Datasets (CT, MRI, PET).
15. Three - Dimensional Medical Image Visualization – Volume Rendering and Surface Rendering Techniques.

TOTAL:45 PERIODS

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BoS / BME 02 / 05 / 2

OUTCOMES:

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

- Implement image representation, quantization, and histogram processing techniques to improve medical image quality.
- Design filtering and restoration techniques to reconstruct and enhance degraded medical images.
- Develop image analysis strategies using edge operators, segmentation methods, and feature descriptors.
- Implement advanced image processing techniques to refine, denoise, and compress medical images.
- Construct medical image solutions using compression methods, multimodal registration, and 3D visualization approaches.

Mapping of Cos with POs and PSOs

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

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BoS / BME

24BM603L **MINI PROJECT-II** **L T P C**
0 0 2 1

OBJECTIVES

The student should be made to:

- Analyze the problems and needs of society and industries
- Divide the complex problems into simple modules
- Identify relevant solutions by doing extensive literature survey
- Prepare a schematic diagram about the plan of execution.
- Propose appropriate solutions through the modern tools and techniques

The students may choose a topic and work with due approval from Head of the Department. Students may do the Mini Project in a group. The maximum number of students in a group should not exceed 3. Every student group will be doing their project under the guidance of a faculty member. A comprehensive Mini Project report should be prepared by each group after completing the work to the satisfaction of the Supervisor. The progress of the Mini Project will be evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. The review committee will be a two-member team. The presence of Mini Project supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 30 PERIODS

Outcomes:

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

- Determine the required solutions for the problem
- Develop strategies to break complex problems into simpler modules
- Experiment and do analysis on the empirical data arrived
- Create documentation on the experimental output and prepare presentation
- Demonstrate the project ideas to the reviewers and continues to improve the performance

Mapping of COs with Pos and PSOs

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

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BoS/BME 02/05/26

24EEC601L	EMPLOYABILITY SKILLS (Common to All Branches)	L T P C 0 0 2 1

OBJECTIVES:

The students should be made to:

- Learn the application of mathematical and project management to different contexts.
- Focus on quantitative ability and employment skills through modern practices.
- Enhance job skills and analytical ability of students
- Improve reasoning skills and employability skills
- Practice the skills on logical reasoning and interview techniques

UNIT I INTRODUCTION TO NUMERIC ABILITY AND PROJECT MANAGEMENT **6**

Aptitude - Ratio and proportion, Partnership, Allegation or Mixtures, Coding - Decoding, Number sequence.
Soft Skills - Managerial skills - Project Cost, risk and Task management, Conflict Management and Resolution.

UNIT II QUANTITATIVE ANALYSIS AND EMPLOYERS EXPECTATIONS **6**

Aptitude - Number system, Data Interpretation, Chain rule, Surds and Indices, Direction Sense.
Soft Skills - Employers Needs and Expectations, Mind Mapping, Situation Reaction Test (SRT).

UNIT III ANALAYTICAL SKILLS AND JOB READINESS **6**

Aptitude - Combination, Probability, Problems on Ages, Seating Arrangements.
Soft Skills - Job Application - Resume Building - Exploring and Identifying Career Options.

UNIT IV REASONING ABILITY AND INSIGHT ON INTERVIEWS **6**

Aptitude - Menstruations, SI and CI, Cause and Effect, Statement, Assumptions and Conclusions
Soft Skills - Interview Techniques, Job Description, Roles and Responsibilities - Work Etiquettes

UNIT V LOGICAL REASONING AND READY RECKNOERS FOR INTERVIEWS **6**

Aptitude - Input-Output Tracing – Trains – Calendar - Blood Relations.
Soft Skills - Types of Interviews, Interview Process, Analyzing the Interviewer, HR Questions & Mock Interviews.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Develop numerical ability and project management skills
- Achieve quantitative skills and employability skills.
- Understand both analytical and job readiness in a productive manner
- Acquire reasoning ability and interview techniques
- Obtain logical skills and interviewers' expectations

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TEXT BOOKS:

1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing New Delhi, Revised Edition, 2024.
2. Rajat Gupta, "Soft Skills: Tools for Success", Yking Books, Second Edition, 2022.

REFERENCE BOOKS:

1. Oswaal Editorial Board, "Objective Quantitative Aptitude for All Competitive Examinations" Oswaal Books and Learning Private Limited, New Edition,2025.
2. M. S. Rao, "Soft Skills: Enhancing Employability" I.K. International Publishing House, Revised Edition, 2025.

USEFUL WEBLINKS:

1. https://learnenglish.britishcouncil.org/
2. https://www.engvid.com/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	2	3	1	1	1	3	2	1	2
CO2	2	1	1	1	1	2	2	2	2	1	2
CO3	2	3	2	2	2	3	2	3	3	1	2
CO4	2	3	2	3	3	2	1	3	2	3	2
CO5	1	1	2	2	3	1	2	3	3	1	2

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BoS (S&H)

24BM701	BIOMECHANICS	L T P C 3 0 0 3

OBECTIVES:

The student should be made to:

- Apply fundamental principles of biomechanics to analyze human motion, body loads, and tissue mechanics.
- Investigate the principles of biofluid mechanics to study fluid behaviour in the cardiovascular system, blood rheology, and extracorporeal circuits.
- Examine the mechanical behaviour of bones, cartilage, and joints to study structural properties, joint kinetics, lubrication, and bone remodeling.
- Investigate mathematical modelling techniques such as finite element analysis, pulse wave velocity, and elasticity determination.
- Explore biomechanical applications in human locomotion, joint mechanics, vibration response, sports performance, and assistive technologies.

UNIT I INTRODUCTION TO BIOMECHANICS 9

Scope of Mechanics in Medicine, Forms of Motion, Kinetics of Human Motion, Loads on the Human Body, Stress- Strain Characteristics, Viscoelasticity and its Models, Levers and its type, Review on Anthropometry.

UNIT II BIO FLUID MECHANICS 9

Newtonian and Non-Newtonian Fluids, Blood Rheology, Laminar and Turbulent Flow, Heart Valves, Power Developed by the Heart, Dynamics of Fluid Flow in Cardiovascular System and Effect of Vibration - Shear Stresses in Extra-Corporeal Circuits, Microcirculation.

UNIT III ORTHOPAEDIC MECHANICS 9

Mechanics of Bone Structure, Mechanical Properties of Cartilage, Diffusion Properties of Articular Cartilage, Kinetics and Kinematics of Joints, Lubrication of Joints, Wolff 's Law of Bone Remodeling

UNIT IV FINITE ELEMENT ANALYSIS 9

Introduction to Finite Element Analysis, Mathematical Models – Case Study - Applications in the Design of Implants. Pulse Wave Velocities in Arteries, Determination of In-Vivo Elasticity of Blood Vessel, Dynamics of Fluid Filled Catheters.

UNIT V APPLICATIONS OF BIOMECHANICS 9

Dynamic Analysis of Human Locomotion - Gait Analysis (Determination of Instantaneous Joint Reaction Analysis), Mechanics of Knee Joint during Standing and Walking, Occupant Response to Vehicular Vibration, Sports Mechanics. Case Study on Exoskeleton.

TOTAL: 45 PERIODS

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BoS/BME 02/05/26

OUTCOMES:

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

- Evaluate biomechanics principles in human movement and structural analysis of the body.
- Analyze fluid mechanics concepts to evaluate blood flow, heart dynamics, shear stresses, and microcirculation.
- Assess orthopaedic mechanics to determine bone structure, cartilage properties, joint dynamics, lubrication, and remodelling processes.
- Formulate mathematical models to interpret arterial dynamics, blood vessel elasticity, catheter behaviour, and implant performance.
- Demonstrate biomechanical principles through gait analysis, joint evaluation, vibration response, sports mechanics, and exoskeleton case studies.

TEXT BOOKS:

1. Fung, Yuan-cheng. Biomechanics: mechanical properties of living tissues. Springer Science & Business Media, 2013.
2. Ethier, C. Ross, and Craig A. Simmons. Introductory biomechanics: from cells to organisms. Cambridge University Press, 2007.

REFERENCES:

1. Susan J Hall, "Basics of Biomechanics'', Mc Graw Hill Publishing.co. New York, 5th Edition,2007.
2. Dhanjoo N.Ghista, "Orthopaedic Mechanics", Academic Press, 1990.
3. B.H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber, "Medical Physics and Biomedical Engineering'', CRC Press, 1999.
4. Subrata pal, Text book of Biomechanics, Viva education private limited, 2009.
5. David A. Winter, Biomechanics and Motor Control of Human Movement
6. Margareta Nordin and Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System.

Mapping of Cos with Pos and PSOs

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

Chairman
BoS/BME

24BM702 **EMBEDDED SYSTEMS AND IoMT** L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Provide foundational knowledge of embedded processors, architectures, and memory systems.
- Develop skills in peripheral interfacing and communication protocols through case studies.
- Impart competence in embedded software design, modeling techniques, and optimization.
- Introduce IoT system development, hardware platforms, and cybersecurity principles.
- Explore IoMT applications in healthcare through real-world case studies and innovations.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Embedded processors: introduction, application areas, categories - Challenges in design, requirements & specifications - Hardware and software architectures - Harvard & Von Neumann, CISC & RISC architectures - CPU bus organization, memory devices (RAM, Flash, EEPROM, DRAM, Device Drivers).

UNIT II PERIPHERAL INTERFACING 9

I/O devices, timers, counters, watchdogs, interrupts - A/D and D/A converters - Memory interfacing with case study - I/O device interfacing with case study - Interfacing protocols: SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth.

UNIT III EMBEDDED SYSTEM SOFTWARE DESIGN 9

Application and system software - Design techniques: state diagrams, sequence diagrams, flowcharts - Model-based system engineering (MBSE), Embedded C/C++ programming - BIOS, POST - IDE tools: editor, compiler, linker, debugger - Optimization: execution time, energy & power.

UNIT IV DESIGN AND DEVELOPMENT OF IOT 9

IoT definition, characteristics, technical building blocks - Physical design of IoT - IoT protocols (MQTT, CoAP) - Sensors, sensor nodes, interfacing with embedded boards (Arduino, Raspberry Pi, ARM Cortex, Intel Galileo) - Communication technologies - Cybersecurity basics: vulnerabilities, penetration & encryption.

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.

TOTAL: 45 PERIODS

Chairman
BoS/BME 02/05/26

OUTCOMES:

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

- Explain the fundamentals of embedded processors, architectures, buses, and memory systems.
- Apply peripheral interfacing techniques and communication protocols to design embedded applications.
- Design and analyze embedded software using modelling techniques, C/C++ programming, and IDE tools with performance optimization.
- Develop IoT systems using sensors, embedded boards, and communication technologies with awareness of cybersecurity principles.
- Evaluate and innovate IoMT applications for healthcare through case studies, integrating mobile and cloud environments securely.

TEXT BOOKS:

1. Peter Marwedel – Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things (Springer, 2021).
2. Embedded Systems – A Contemporary Design Tool, James K Peckol, , John Weily, 2008, ISBN: 0- 444-51616-6.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
4. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, "Internet of Things and Personalized Healthcare Systems", Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCE BOOKS:

1. Shibu K V – Introduction to Embedded Systems, Tata McGraw Hill, 2009.
2. David E. Simon – Embedded Software Primer, Addison Wesley.
3. Barry B. Brey – The Intel Microprocessors: Architecture, Programming and Interfacing, 6th Edition, Pearson Education.
4. Arshdeep Bahga & Vijay Madisetti – Internet of Things: A Hands-on Approach, Universities Press, 2015.
5. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat – Internet of Things and Personalized Healthcare Systems, Springer, 2019.
6. Olivier Hersent et al. – The Internet of Things: Key Applications and Protocols, Wiley, 2012.

Mapping of Cos with POs and PSOs

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

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BoS/BME

24BM703	HOSPITAL MANAGEMENT	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Identify the distinctions between hospitals and industries, challenges in administration, and key aspects of hospital planning and management.
- Utilize hospital HRM principles in manpower planning, recruitment, training, and communication for effective workforce management.
- Make use of marketing research principles, digital health marketing, and consumer behaviour models for effective hospital management decisions.
- Organize hospital information systems and supportive services, integrating clinical, administrative, and technical functions for effective healthcare delivery.
- Analyze quality assurance frameworks, safety management systems, and accreditation requirements in healthcare organizations.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry – Challenges in Hospital Administration – Hospital Planning: Digital Infrastructure Planning, Equipment Planning, Functional Planning – Telemedicine & e-Health Systems – Current Issues in Hospital Management – Bio-Medical Waste & E-Waste Management

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles and Functions of HRM – Profile of HRD Manager – Tools of HRD – Human Resource Inventory – Manpower Planning – Competency Mapping and Talent Acquisition (new inclusion) – Recruitment, Selection – Training & Development: Digital Training Platforms – Evaluation of Training – Leadership Grooming & Succession Planning – Promotion, Transfer – Communication: Nature, Scope, Barriers, Styles and Modes.

UNIT III MARKETING RESEARCH PROCESS 9

Marketing Information Systems – Assessing Information Needs – Developing and Disseminating Information – Market Research Process – Digital Health Marketing & Social Media Analytics (new inclusion) – Consumer Markets and Consumer Buyer Behaviour – Models of Consumer & Business Buyer Behaviour – Major Types of Buying Situations – WTO and Its Implications

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirements – Clinical Information Systems – Administrative Information Systems – Support Service Technical Information Systems – Electronic Health Records (EHR) Medical Transcription – Medical Records Department – Central Sterilization & Supply Department – Pharmacy – Food Services.

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UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality System – Elements, Implementation, Documentation, Quality Auditing – International Standards: ISO 9000–9004, Features of ISO 9001, ISO 14000 – Environment Management Systems – NABA, JCI, NABL – Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules – Hazard & Risk Assessment – Patient Safety Indicators & Clinical Risk Management– Health Insurance & Managing Health Care – Medical Audit.

TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students be able to,

- Differentiate hospitals from industries and explain planning, digital infrastructure, and waste management challenges.
- Apply human resource management concepts including manpower planning, competency mapping, training, and leadership development in hospitals
- Demonstrate knowledge of healthcare marketing strategies, digital marketing tools, social media analytics, and global implications like WTO.
- Evaluate the role of hospital information systems, EHR, interoperability standards, and supportive services for effective hospital operations.
- Assess quality and safety frameworks (ISO, NABH, JCI, NABL), risk management, fire and security protocols, and patient safety indicators in hospitals.

TEXTBOOKS:

1. Goyal R.C., Hospital Administration and Human Resource Management, PHI Learning Pvt Ltd, 2017.
2. Kunders G.D., Hospitals – Facilities Planning and Management, Tata McGraw Hill, New Delhi, Fifth Reprint, 2007.

REFERENCES:

1. Cesar A Caceres and Albert Zara, The Practice of Clinical Engineering, Academic Press, New York 1977.
2. Norman Metzger, Handbook of Health Care Human Resources Management, 2nd Edition, Aspen Publication Inc., 1990.
3. Peter Berman, Health Planning for Effective Management, Oxford University Press, 1988.
4. Blane & Brunner, Health and Social Organization: Towards a Health Policy for the 21st Century, Eric Calrendon Press, 2002.
5. Arnold D. Kalcizony & Stephen M. Shortell, Health Care Management, 6th Edition, Cengage Learning, 2011.

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Mapping of COs with POs and PSOs

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

Chairman
BoS/BME 02/05/26

24BM704L HOSPITAL TRAINING **L T P C**
0 0 2 1

OBJECTIVES:

The student should be made to:

- 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
- Enrich the importance of inter-professional relationships with health professionals
- Aware of the role to address the healthcare needs

ASSESSMENT

- Students need to complete training in any leading Multi-Specialty 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.

S. No.	Departments to Visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre
7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
13	Obstetrics and Gynaecology
14	Emergency Medicine
15	Biomedical Engineering Department
16	Histo Pathology
17	Bio Chemistry
18	Paediatric / Neonatal
19	Dental
20	Oncology
21	PAC's(Pre Anaesthetic Check
22	Medical Records / Telemetry

TOTAL: 30 PERIODS

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BoS/BME 12/5/26

OUTCOMES:

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

- Advocate a patient-centred approach in health care
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional health improvement plan based upon the patient's perceived needs
- Propose a patient centred inter professional health improvement plan based upon the patients perceived needs
- Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients need

Mapping of POs, COs with PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1	1	3	3	2	2	1	2	2	1
CO2	1	2	1	1	1	2	3	3	3	2	2	1	1
CO3	2	3	2	2	2	3	2	2	2	1	2	2	2
CO4	2	3	3	2	2	3	2	2	2	2	2	2	2
CO5	2	3	2	2	2	3	3	3	2	2	3	2	2

Chairman
BoS/BME

24BM705L EMBEDDED SYSTEMS AND IoMT LABORATORY **L T P C**
0 0 2 1

OBJECTIVES:

The student should be made to:

- Acquire practical knowledge of embedded processors, architectures, and memory systems.
- Develop skills in peripheral interfacing and communication protocols.
- Strengthen competence in embedded software design and optimization.
- Build IoT systems using sensors, embedded boards, and communication technologies.
- Explore IoMT applications in healthcare through sensor-based case studies and mini projects.

LIST OF EXPERIMENTS

1. Explore microcontroller platforms (AVR/ARM/Arduino) using Embedded C.
2. Write an simple arithmetic and logical programs in Embedded C.
3. Write Program interrupts and timers for basic event handling.
4. Develop real-time applications – digital clock and counter.
5. Demonstrate communication methods with IoT devices.
6. Interface LED/Buzzer with Arduino/Raspberry Pi and control with delay routines.
7. Interface DC motor using relay and push-button control.
8. Test infrared sensor and develop a simple IoT application.
9. Interface DHT11 sensor and display temperature/humidity readings.
10. Deploy a simple IoMT application using healthcare sensors (Temperature, ECG, Pulse, etc.,).
11. Case Study: IoMT Application Deployment.
12. Mini Project.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Demonstrate basic programming skills with embedded processors and memory systems.
2. Apply peripheral interfacing and communication methods in simple embedded applications.
3. Develop real time programs using interrupts, timers, and counters.
4. Construct IoT systems by integrating sensors, embedded boards, and communication protocols.
5. Design and deploy basic IoMT applications for healthcare monitoring through mini projects.

Mapping of Cos with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
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	–

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24BM801L	PROJECT WORK	L T P C 0 0 20 10

OBJECTIVES:

The student should be made to:

- Develop the ability to solve a specific problem right from its identification
- Do the literature review to know any recent work has been carried out on the problem
- Acquire sufficient inputs for preparing project reports
- Prepare themselves for presenting the project work carried out
- Accumulate as many information as possible to face reviews, comments and implement the suggestions

The students may choose a topic and work with due approval from Head of the Department. The students may do the project in a group. The maximum number of students in a group should not exceed 3. Every student member in a group will be doing their project under the guidance of a faculty member. A comprehensive project report should be prepared by each group after completing the work to the satisfaction of the Supervisor. The progress of the project will be evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The review committee will be a three-member team. The presence of project Supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 300 PERIODS

OUTCOMES:

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

- Apply all the fundamental knowledge acquired to solve problems.
- Design and develop solutions for the complex problems of the society using modern tools and ensure environmental sustainability.
- Explain the identified problem with appropriate presentation and documentation.
- Interpret issues taken up with the required ethical standards and communicate to the need of the society.
- Demonstrate the need for independent and lifelong learning in the broadest sense of technological change.

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Mapping of POs, COs with PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	1	1	1	1	2	3	2
CO2	3	3	3	2	3	3	2	2	2	2	2	3	3
CO3	2	2	1	1	1	1	1	2	3	1	2	1	1
CO4	1	2	1	1	1	3	3	2	3	1	2	1	1
CO5	2	2	1	1	2	2	2	2	3	1	3	2	2

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24BM101PE	GENETIC ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe tools and techniques in recombinant DNA technology
- Explain DNA library construction and artificial chromosomes
- Apply PCR and sequencing methods for DNA analysis
- Analyse genome organization and sequencing strategies
- Evaluate genomic technologies and their applications

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, Proteogenomic, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL:45 PERIODS

OUTCOMES:

On successful completion of this course, the students be able to,

- Recall key components of recombinant DNA methods
- Summarize DNA library creation and chromosome tools
- Use PCR and sequencing techniques in experiments
- Interpret genome sequencing and mapping data
- Assess genomic tools for functional and comparative studies

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TEXT BOOKS:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", 6th Edition Blackwell Science Publications, 2001.
2. S.B.Primrose and R.M.Twyman, "Principles of Genome Analysis and Genomics" 3rd Edition. Blackwell Publishing, 2006

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.

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM102PE	BIOMETRIC SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe biometric technologies, characteristics, and performance metrics
- Explain fingerprint recognition techniques and evaluation methods
- Apply algorithms for face and hand geometry recognition
- Analyse IRIS recognition systems and performance factors
- Evaluate voice scan and multimodal biometric systems for secure authentication

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).

TOTAL:45 PERIODS

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OUTCOMES:

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

- Recall key biometric modalities and system accuracy metrics
- Summarize fingerprint recognition methods and assess algorithm strengths
- Implement face and hand geometry recognition using feature extraction techniques
- Examine iris recognition approaches and interpret system performance
- Assess multimodal biometric architectures and security strategies

TEXT BOOKS:

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
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 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.

Mapping of COs with POs and PSOs

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

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24BM103PE	NEURAL ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe neuron structure, glial cells, and synaptic functions.
- Explain brain and spinal cord anatomy and physiology
- Analyze mechanisms of neurodegenerative and demyelinating disorders
- Evaluate neurophysiological and imaging techniques
- Design nerve regeneration and rehabilitation strategies

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. Blood supply 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:45 PERIODS

OUTCOMES:

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

- Identify and recall the structural components of neurons, glial cells, and synaptic mechanisms
- Summarize the functional anatomy of the brain, brain stem, and spinal cord, including sensory and motor pathways
- Examine and interpret the causes and progression of major neuronal disorders such as Alzheimer's and Parkinson's

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- Assess the effectiveness of neurophysiological tools and imaging techniques in diagnosing and studying neural activity
- Develop and propose solutions for nerve repair and rehabilitation using neural engineering technologies

TEXT BOOKS:

1. Mathews G.G., "Neurobiology", 2nd edition, Blackwell Science, UK, 2000
2. Malcom Carpenter, "Textbooks of Neuroanatomy", Mc. Graw hill Edition, 1996

REFERENCES:

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

Mapping of COs with POs and PSOs

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

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24BM104PE	BIOPHOTONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Get familiarized with various principles of Optical Imaging systems
- Appreciate the applications of Biosensors in medicine
- Evaluate the limitations and advantages of flow cytometers in analyzing heterogeneous cell populations
- Understand the importance of phototherapy in treatment of diseases
- Learn various nanoparticles and nanorods for biosensing

UNIT I BIO IMAGING **9**

Bio imaging: An introduction – Transmission Microscopy – Simple Microscope, Compound Microscope – Kohler illumination, Numerical Aperture and Resolution – Optical aberrations and different types of objectives – Phase Contrast Microscopy – Dark Field Microscopy – DICM – Fluorescence microscopy, Scanning Microscopy – Inverted and Upright Microscopes – Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography – Total Internal Reflection Fluorescence Microscopy – Near field Optical Microscopy – FLIM

UNIT II OPTICAL BIOSENSORS **9**

Biosensors: An Introduction – Principles of Optical Bio Sensing: Bio Recognition, Optical Transduction – Fluorescence Sensing – Fluorescence energy transfer sensors – Molecular beacons – Optical geometries of bio sensing – Immobilization of bio recognition elements – Fiber Optic biosensors – Planar waveguide biosensors – Evanescent wave biosensors – Interferometric biosensors – Surface Plasmon resonance biosensors.

UNIT III FLOW CYTOMETRY **9**

Basics of flow cytometry – Basic steps of flow cytometry – Components of cytometer – Optical response – Fluorochromes for flow cytometry – Data manipulation and presentation.

UNIT IV PHOTODYNAMIC THERAPY **9**

Photodynamic Therapy: Basic principles – Photosensitizers for Photodynamic therapy – Light Irradiation for photodynamic therapy: Light Source, LASER dosimetry, Light delivery – Mechanism of Photodynamic action – Two photon photodynamic therapy.

UNIT V BIONANOPHOTONICS **9**

Interface of Bioscience – Nanotechnology and Photonics – Nanochemistry – Semiconductor quantum dots for bioimaging – Metallic nanoparticles and nanorods for Biosensing – Up converting nanophopes – Probes Encapsulated by biologically localized embedding (PEBBLE) nanosensors for in vitro bioanalysis – Nanoclincs for optical diagnostics and targeted therapy.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Differentiate the various principles of optical imaging systems
- Outline the various applications of Biosensors in medicine
- Analyze the working principle of flow cytometer
- Describe the importance of phototherapy in treatment of diseases
- Explain about the various nanoparticles and nanorods for biosensing

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TEXT BOOKS:

1. Paras N Prasad, *"Introduction to Biophotonics"*, John Wiley & Sons, First Edition, 2003.
2. Jurgen Pop, Valery V Techin, Arthur Chiou and Stefen Heinemann, *"Handbook of Biophotonics"*, Vol 2: Photonics for Health Care, John Wiley & Sons, First Edition, 2012.

REFERENCES:

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S Tanev, Harold Sackman, *"Advances in Biophotonics"*, IOS Press, First Edition, 2012.
2. Paras N Prasad, *"Nanophotonics"*, John Wiley & Sons, First Edition, 2004.

Mapping of COs with POs and PSOs

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

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24BM105PE	MEDICAL OPTICS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Illustrate about the optical properties of the tissues and the interactions of light with tissues
- Assess the suitability of different optical components for specific biomedical imaging applications
- Learn about the Medical Lasers and their applications
- Have an overview of the optical diagnostic application
- Appreciate the emerging optical diagnostic and therapeutic techniques

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Fundamental Properties of light – Refraction, Reflection, Laws (Snell's law and Fresnel law) Scattering, Absorption, Light transport inside the tissue, Tissue properties, LASER characteristics as applied to medicine and biology, LASER tissue interactions – Photo chemical, Photo thermal and Photo mechanical interactions, Fluorescence, Speckles, Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, Excitation light sources – high pressure arc lamps, LEDs, LASERS, Optical filters – Prism and Monochromators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

UNIT III SURGICAL THERAPEUTIC APPLICATIONS OF LASERS 9

LASERS in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV NON-THERMAL DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, LASER induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and imaging, FLIM – Holographic and Speckle applications of LASERS in biology and medicine.

UNIT V DIAGNOSTIC AND THERAPEUTIC TECHNIQUES 9

Near field imaging of biological structures, In vitro clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) – Principles and mechanisms – Oncological and non-oncological applications of PDT – Biostimulation effect – applications – LASER safety procedures.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate knowledge of the fundamentals of optical properties of tissues
- Analyze the components of instrumentation in Medical Photonics and Configurations
- Describe surgical applications of LASERS
- Describe photonics and its diagnostic applications
- Investigate emerging techniques in medical optics

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TEXT BOOKS:

1. Tuan Vo Dirh, *"Biomedical Photonics – Handbook"*, CRC Press, Boca Raton, 2014.
2. Paras N Prasad, *"Introduction to Biophotonics"*, A John Wiley and Sons Inc. Publications, 2003.

REFERENCES:

1. Markolf H Niemz, *"LASER-Tissue Interaction Fundamentals and Applications"*, Springer, 2007.
2. David Baxter G, *"Therapeutic LASERS – Theory and Practice"*, Churchill Livingstone Publications, Edition-2001.
3. Leon Goldman, M D and James Rockwell R Jr, *"LASERS in Medicine"*, Gordon and Breach, Science Publishers Inc., 1975.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	1	-	1
CO2	3	3	2	1	3	1	-	-	1	-	1
CO3	3	2	1	-	2	1	-	-	1	-	1
CO4	3	2	1	-	2	1	-	-	1	-	1
CO5	3	3	2	3	3	2	-	-	2	1	3

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BoS/BME

24BM106PE PRINCIPLES OF TISSUE ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

- Describe cell types, growth, differentiation, and cell culture techniques
- Explain tissue organization, ECM components, and wound healing mechanisms
- Classify stem cell types, sources, and their biological properties
- Analyze engineering methods for scaffold fabrication and cell patterning
- Evaluate tissue engineering applications and commercialization strategies

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, pluripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pluripotent 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 :45 PERIODS

OUTCOMES:

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

- Recall key concepts in cell biology including cell culture and signaling
- Summarize tissue types, ECM roles, and healing processes
- Identify and differentiate stem cell types and their sources
- Examine scaffold fabrication techniques and cell-material interactions
- Assess tissue engineering applications in organ replacement and regeneration

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TEXT BOOKS:

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

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM107PE PHYSIOLOGY FOR ENGINEERS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Get familiarized with core physiological systems structure, function, and engineering relevance
- Appreciate homeostasis, feedback control, and their implications for biomedical device design
- Learn quantitative modeling techniques applied to physiological systems
- Understand how physiological constraints inform engineering solutions
- Apply engineering analysis to physiological dysfunctions and corrective strategies

UNIT I: FOUNDATIONS OF PHYSIOLOGICAL SYSTEMS **9**

Overview of human physiological systems, homeostasis, and feedback regulation Cell physiology: membrane potential, transport, and signal transduction Introduction to quantitative approaches and modeling in physiology.

UNIT II: NERVOUS & MUSCULAR SYSTEMS **9**

Neural communication: action potentials, synaptic transmission, system modeling Muscle physiology: skeletal and smooth muscle mechanics, excitation–contraction coupling Engineering analysis: equivalent circuit modeling, muscle force–length and force–velocity relationships.

UNIT III: CARDIOVASCULAR & RESPIRATORY PHYSIOLOGY **9**

Cardiovascular dynamics: heart function, blood flow, pressure regulation, compliance and resistance modeling Respiratory mechanics: lung ventilation, gas exchange, airway resistance, and respiratory control Modeling interactions and implications for device design (e.g., ventilators, hemodynamic monitoring).

UNIT IV: RENAL & ENDOCRINE SYSTEMS **9**

Kidney function: filtration, reabsorption, acid–base balance, fluid regulation, glomerular filtration rate modeling Endocrine regulation: hormone signaling, feedback loops (e.g., insulin–glucose regulation), dynamic modeling.

UNIT V: ENGINEERING APPLICATIONS & CASE STUDIES **9**

Quantitative case analyses: modeling physiological dysfunctions and restoration strategies Examples: cardiac assist devices, artificial ventilation control, insulin pumps Discussion of design constraints, ethical considerations, and device–body integration.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe and model key physiological systems through engineering lenses
- Analyze homeostatic control and feedback in organ systems
- Develop quantitative models representing physiological functions
- Interpret physiological limitations in the design of biomedical systems
- Propose engineering-based interventions for physiological dysfunction

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TEXTBOOKS:

1. Kim E. Barrett, Susan M. Barman, Heddwen L. Brooks, Jason X.-J. Yuan, "Ganong's Review of Medical Physiology", McGraw-Hill Education, 26th Edition, United States, 2019.
2. Joseph J. Feher, "Quantitative Human Physiology: An Introduction", Academic Press (Elsevier), 2nd Edition, United States, 2016.

Mapping of COs with POs and PSOs

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

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24BM108PE BIOINFORMATICS: ALGORITHMS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Familiarize with nucleotide and protein sequence databases and retrieval methods
- Understand and apply alignment algorithms, substitution matrices, and phylogenetic analysis
- Gain hands-on experience with structural bioinformatics: secondary/tertiary structure prediction and analysis
- Analyze protein stability, folding kinetics, and mutational impacts using computational tools
- Explore computer-aided drug design workflows, basic algorithm development, and machine learning applications

UNIT I: SEQUENCE ANALYSIS & DATABASES **9**

Introduction to bioinformatics and biological data sources DNA sequence analysis: formats, quality control, genomic databases Protein sequence databases: UniProt, RefSeq, non-redundant sets Fundamentals of sequence alignment: pairwise alignment concepts.

UNIT II: ALIGNMENT ALGORITHMS & PHYLOGENY **9**

Substitution matrices (PAM, BLOSUM) and scoring schemes Global vs. local alignment algorithms (Needleman–Wunsch, Smith–Waterman) BLAST family: features, statistical significance, perpetration of scores Multiple sequence alignment: CLUSTAL, MAFFT; conservation scoring Phylogenetic tree construction: distance-based and character-based methods.

UNIT III: STRUCTURAL BIOINFORMATICS **9**

Hydrophobicity and sequence-based profiles for structure inference Secondary structure: Ramachandran plots, propensities, prediction algorithms (PSIPRED, JPred) Tertiary structure: Protein Data Bank overview, visualization (PyMOL, Chimera) Structural classification: SCOP, CATH; contact map generation.

UNIT IV: STRUCTURAL BIOINFORMATICS II & STABILITY **9**

Protein structure prediction: homology modeling, threading, ab initio approaches Protein stability: energetic contributions, stability databases (ProTherm), stabilizing/destabilizing mutations Folding kinetics: rate determinants, folding pathway models Protein–protein interactions and binding site residue identification.

UNIT V: APPLICATIONS & ALGORITHM DEVELOPMENT **9**

Computer-aided drug design: molecular docking, virtual screening, QSAR fundamentals Algorithm implementation: AWK scripting for data parsing Introduction to machine learning in bioinformatics: feature extraction, classification/regression pipelines Hands-on with WEKA: model training, evaluation, and application to biological datasets

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Retrieve and curate biological sequence data from major public repositories
- Execute and interpret pairwise, multiple sequence alignments, and phylogenetic analyses
- Predict and analyze protein secondary/tertiary structures using state-of-the-art tools
- Assess and model protein stability, folding kinetics, and mutational effects computationally
- Design and implement basic bioinformatics algorithms and apply machine learning techniques to biological problems

TEXTBOOKS:

1. M. Michael Gromiha, "Protein Bioinformatics: From Sequence to Function", Academic Press, 2010.
2. D.E. Krane and M.L. Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education Inc., 2006.

Mapping of COs with POs and PSOs

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

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24BM101PE	GENETIC ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe tools and techniques in recombinant DNA technology
- Explain DNA library construction and artificial chromosomes
- Apply PCR and sequencing methods for DNA analysis
- Analyse genome organization and sequencing strategies
- Evaluate genomic technologies and their applications

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, Proteogenomic, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL:45 PERIODS

OUTCOMES:

On successful completion of this course, the students be able to,

- Recall key components of recombinant DNA methods
- Summarize DNA library creation and chromosome tools
- Use PCR and sequencing techniques in experiments
- Interpret genome sequencing and mapping data
- Assess genomic tools for functional and comparative studies

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TEXT BOOKS:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", 6th Edition Blackwell Science Publications, 2001.
2. S.B.Primrose and R.M.Twyman, "Principles of Genome Analysis and Genomics" 3rd Edition. Blackwell Publishing, 2006

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.

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM102PE	BIOMETRIC SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe biometric technologies, characteristics, and performance metrics
- Explain fingerprint recognition techniques and evaluation methods
- Apply algorithms for face and hand geometry recognition
- Analyse IRIS recognition systems and performance factors
- Evaluate voice scan and multimodal biometric systems for secure authentication

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).

TOTAL:45 PERIODS

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OUTCOMES:

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

- Recall key biometric modalities and system accuracy metrics
- Summarize fingerprint recognition methods and assess algorithm strengths
- Implement face and hand geometry recognition using feature extraction techniques
- Examine iris recognition approaches and interpret system performance
- Assess multimodal biometric architectures and security strategies

TEXT BOOKS:

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
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 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.

Mapping of COs with POs and PSOs

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

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24BM103PE	NEURAL ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe neuron structure, glial cells, and synaptic functions.
- Explain brain and spinal cord anatomy and physiology
- Analyze mechanisms of neurodegenerative and demyelinating disorders
- Evaluate neurophysiological and imaging techniques
- Design nerve regeneration and rehabilitation strategies

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. Blood supply 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:45 PERIODS

OUTCOMES:

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

- Identify and recall the structural components of neurons, glial cells, and synaptic mechanisms
- Summarize the functional anatomy of the brain, brain stem, and spinal cord, including sensory and motor pathways
- Examine and interpret the causes and progression of major neuronal disorders such as Alzheimer's and Parkinson's

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- Assess the effectiveness of neurophysiological tools and imaging techniques in diagnosing and studying neural activity
- Develop and propose solutions for nerve repair and rehabilitation using neural engineering technologies

TEXT BOOKS:

1. Mathews G.G., "Neurobiology", 2nd edition, Blackwell Science, UK, 2000
2. Malcom Carpenter, "Textbooks of Neuroanatomy", Mc. Graw hill Edition, 1996

REFERENCES:

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

Mapping of COs with POs and PSOs

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

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24BM104PE	BIOPHOTONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Get familiarized with various principles of Optical Imaging systems
- Appreciate the applications of Biosensors in medicine
- Evaluate the limitations and advantages of flow cytometers in analyzing heterogeneous cell populations
- Understand the importance of phototherapy in treatment of diseases
- Learn various nanoparticles and nanorods for biosensing

UNIT I BIO IMAGING **9**

Bio imaging: An introduction – Transmission Microscopy – Simple Microscope, Compound Microscope – Kohler illumination, Numerical Aperture and Resolution – Optical aberrations and different types of objectives – Phase Contrast Microscopy – Dark Field Microscopy – DICM – Fluorescence microscopy, Scanning Microscopy – Inverted and Upright Microscopes – Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography – Total Internal Reflection Fluorescence Microscopy – Near field Optical Microscopy – FLIM

UNIT II OPTICAL BIOSENSORS **9**

Biosensors: An Introduction – Principles of Optical Bio Sensing: Bio Recognition, Optical Transduction – Fluorescence Sensing – Fluorescence energy transfer sensors – Molecular beacons – Optical geometries of bio sensing – Immobilization of bio recognition elements – Fiber Optic biosensors – Planar waveguide biosensors – Evanescent wave biosensors – Interferometric biosensors – Surface Plasmon resonance biosensors.

UNIT III FLOW CYTOMETRY **9**

Basics of flow cytometry – Basic steps of flow cytometry – Components of cytometer – Optical response – Fluorochromes for flow cytometry – Data manipulation and presentation.

UNIT IV PHOTODYNAMIC THERAPY **9**

Photodynamic Therapy: Basic principles – Photosensitizers for Photodynamic therapy – Light Irradiation for photodynamic therapy: Light Source, LASER dosimetry, Light delivery – Mechanism of Photodynamic action – Two photon photodynamic therapy.

UNIT V BIONANOPHOTONICS **9**

Interface of Bioscience – Nanotechnology and Photonics – Nanochemistry – Semiconductor quantum dots for bioimaging – Metallic nanoparticles and nanorods for Biosensing – Up converting nanophopes – Probes Encapsulated by biologically localized embedding (PEBBLE) nanosensors for in vitro bioanalysis – Nanoclincs for optical diagnostics and targeted therapy.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Differentiate the various principles of optical imaging systems
- Outline the various applications of Biosensors in medicine
- Analyze the working principle of flow cytometer
- Describe the importance of phototherapy in treatment of diseases
- Explain about the various nanoparticles and nanorods for biosensing

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TEXT BOOKS:

1. Paras N Prasad, *"Introduction to Biophotonics"*, John Wiley & Sons, First Edition, 2003.
2. Jurgen Pop, Valery V Techin, Arthur Chiou and Stefen Heinemann, *"Handbook of Biophotonics"*, Vol 2: Photonics for Health Care, John Wiley & Sons, First Edition, 2012.

REFERENCES:

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S Tanev, Harold Sackman, *"Advances in Biophotonics"*, IOS Press, First Edition, 2012.
2. Paras N Prasad, *"Nanophotonics"*, John Wiley & Sons, First Edition, 2004.

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM105PE	MEDICAL OPTICS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Illustrate about the optical properties of the tissues and the interactions of light with tissues
- Assess the suitability of different optical components for specific biomedical imaging applications
- Learn about the Medical Lasers and their applications
- Have an overview of the optical diagnostic application
- Appreciate the emerging optical diagnostic and therapeutic techniques

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Fundamental Properties of light – Refraction, Reflection, Laws (Snell's law and Fresnel law) Scattering, Absorption, Light transport inside the tissue, Tissue properties, LASER characteristics as applied to medicine and biology, LASER tissue interactions – Photo chemical, Photo thermal and Photo mechanical interactions, Fluorescence, Speckles, Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, Excitation light sources – high pressure arc lamps, LEDs, LASERS, Optical filters – Prism and Monochromators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

UNIT III SURGICAL THERAPEUTIC APPLICATIONS OF LASERS 9

LASERS in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV NON-THERMAL DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, LASER induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and imaging, FLIM – Holographic and Speckle applications of LASERS in biology and medicine.

UNIT V DIAGNOSTIC AND THERAPEUTIC TECHNIQUES 9

Near field imaging of biological structures, In vitro clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) – Principles and mechanisms – Oncological and non-oncological applications of PDT – Biostimulation effect – applications – LASER safety procedures.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate knowledge of the fundamentals of optical properties of tissues
- Analyze the components of instrumentation in Medical Photonics and Configurations
- Describe surgical applications of LASERS
- Describe photonics and its diagnostic applications
- Investigate emerging techniques in medical optics

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TEXT BOOKS:

1. Tuan Vo Dirh, *"Biomedical Photonics – Handbook"*, CRC Press, Boca Raton, 2014.
2. Paras N Prasad, *"Introduction to Biophotonics"*, A John Wiley and Sons Inc. Publications, 2003.

REFERENCES:

1. Markolf H Niemz, *"LASER-Tissue Interaction Fundamentals and Applications"*, Springer, 2007.
2. David Baxter G, *"Therapeutic LASERS – Theory and Practice"*, Churchill Livingstone Publications, Edition-2001.
3. Leon Goldman, M D and James Rockwell R Jr, *"LASERS in Medicine"*, Gordon and Breach, Science Publishers Inc., 1975.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	1	-	1
CO2	3	3	2	1	3	1	-	-	1	-	1
CO3	3	2	1	-	2	1	-	-	1	-	1
CO4	3	2	1	-	2	1	-	-	1	-	1
CO5	3	3	2	3	3	2	-	-	2	1	3

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BoS/BME

24BM106PE PRINCIPLES OF TISSUE ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

- Describe cell types, growth, differentiation, and cell culture techniques
- Explain tissue organization, ECM components, and wound healing mechanisms
- Classify stem cell types, sources, and their biological properties
- Analyze engineering methods for scaffold fabrication and cell patterning
- Evaluate tissue engineering applications and commercialization strategies

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, pluripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pluripotent 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 :45 PERIODS

OUTCOMES:

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

- Recall key concepts in cell biology including cell culture and signaling
- Summarize tissue types, ECM roles, and healing processes
- Identify and differentiate stem cell types and their sources
- Examine scaffold fabrication techniques and cell-material interactions
- Assess tissue engineering applications in organ replacement and regeneration

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TEXT BOOKS:

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

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM107PE PHYSIOLOGY FOR ENGINEERS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Get familiarized with core physiological systems structure, function, and engineering relevance
- Appreciate homeostasis, feedback control, and their implications for biomedical device design
- Learn quantitative modeling techniques applied to physiological systems
- Understand how physiological constraints inform engineering solutions
- Apply engineering analysis to physiological dysfunctions and corrective strategies

UNIT I: FOUNDATIONS OF PHYSIOLOGICAL SYSTEMS **9**

Overview of human physiological systems, homeostasis, and feedback regulation Cell physiology: membrane potential, transport, and signal transduction Introduction to quantitative approaches and modeling in physiology.

UNIT II: NERVOUS & MUSCULAR SYSTEMS **9**

Neural communication: action potentials, synaptic transmission, system modeling Muscle physiology: skeletal and smooth muscle mechanics, excitation–contraction coupling Engineering analysis: equivalent circuit modeling, muscle force–length and force–velocity relationships.

UNIT III: CARDIOVASCULAR & RESPIRATORY PHYSIOLOGY **9**

Cardiovascular dynamics: heart function, blood flow, pressure regulation, compliance and resistance modeling Respiratory mechanics: lung ventilation, gas exchange, airway resistance, and respiratory control Modeling interactions and implications for device design (e.g., ventilators, hemodynamic monitoring).

UNIT IV: RENAL & ENDOCRINE SYSTEMS **9**

Kidney function: filtration, reabsorption, acid–base balance, fluid regulation, glomerular filtration rate modeling Endocrine regulation: hormone signaling, feedback loops (e.g., insulin–glucose regulation), dynamic modeling.

UNIT V: ENGINEERING APPLICATIONS & CASE STUDIES **9**

Quantitative case analyses: modeling physiological dysfunctions and restoration strategies Examples: cardiac assist devices, artificial ventilation control, insulin pumps Discussion of design constraints, ethical considerations, and device–body integration.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe and model key physiological systems through engineering lenses
- Analyze homeostatic control and feedback in organ systems
- Develop quantitative models representing physiological functions
- Interpret physiological limitations in the design of biomedical systems
- Propose engineering-based interventions for physiological dysfunction

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TEXTBOOKS:

1. Kim E. Barrett, Susan M. Barman, Heddwen L. Brooks, Jason X.-J. Yuan, "Ganong's Review of Medical Physiology", McGraw-Hill Education, 26th Edition, United States, 2019.
2. Joseph J. Feher, "Quantitative Human Physiology: An Introduction", Academic Press (Elsevier), 2nd Edition, United States, 2016.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	1	3	1
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CO3	3	3	2	3	3	1	-	-	1	-	2	3	2
CO4	3	3	3	2	2	1	1	-	1	-	2	3	2
CO5	3	3	3	3	3	2	1	2	2	2	3	3	3

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24BM108PE BIOINFORMATICS: ALGORITHMS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Familiarize with nucleotide and protein sequence databases and retrieval methods
- Understand and apply alignment algorithms, substitution matrices, and phylogenetic analysis
- Gain hands-on experience with structural bioinformatics: secondary/tertiary structure prediction and analysis
- Analyze protein stability, folding kinetics, and mutational impacts using computational tools
- Explore computer-aided drug design workflows, basic algorithm development, and machine learning applications

UNIT I: SEQUENCE ANALYSIS & DATABASES **9**

Introduction to bioinformatics and biological data sources DNA sequence analysis: formats, quality control, genomic databases Protein sequence databases: UniProt, RefSeq, non-redundant sets Fundamentals of sequence alignment: pairwise alignment concepts.

UNIT II: ALIGNMENT ALGORITHMS & PHYLOGENY **9**

Substitution matrices (PAM, BLOSUM) and scoring schemes Global vs. local alignment algorithms (Needleman–Wunsch, Smith–Waterman) BLAST family: features, statistical significance, perpetration of scores Multiple sequence alignment: CLUSTAL, MAFFT; conservation scoring Phylogenetic tree construction: distance-based and character-based methods.

UNIT III: STRUCTURAL BIOINFORMATICS **9**

Hydrophobicity and sequence-based profiles for structure inference Secondary structure: Ramachandran plots, propensities, prediction algorithms (PSIPRED, JPred) Tertiary structure: Protein Data Bank overview, visualization (PyMOL, Chimera) Structural classification: SCOP, CATH; contact map generation.

UNIT IV: STRUCTURAL BIOINFORMATICS II & STABILITY **9**

Protein structure prediction: homology modeling, threading, ab initio approaches Protein stability: energetic contributions, stability databases (ProTherm), stabilizing/destabilizing mutations Folding kinetics: rate determinants, folding pathway models Protein–protein interactions and binding site residue identification.

UNIT V: APPLICATIONS & ALGORITHM DEVELOPMENT **9**

Computer-aided drug design: molecular docking, virtual screening, QSAR fundamentals Algorithm implementation: AWK scripting for data parsing Introduction to machine learning in bioinformatics: feature extraction, classification/regression pipelines Hands-on with WEKA: model training, evaluation, and application to biological datasets

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Retrieve and curate biological sequence data from major public repositories
- Execute and interpret pairwise, multiple sequence alignments, and phylogenetic analyses
- Predict and analyze protein secondary/tertiary structures using state-of-the-art tools
- Assess and model protein stability, folding kinetics, and mutational effects computationally
- Design and implement basic bioinformatics algorithms and apply machine learning techniques to biological problems

TEXTBOOKS:

1. M. Michael Gromiha, "Protein Bioinformatics: From Sequence to Function", Academic Press, 2010.
2. D.E. Krane and M.L. Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education Inc., 2006.

Mapping of COs with POs and PSOs

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

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24BM301PE	HOSPITAL MANAGEMENT	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the structure, functions, and challenges of hospital administration in the modern digital era.
- Gain knowledge of human resource management strategies tailored to the healthcare environment.
- Learn about healthcare marketing, digital promotion, and consumer behaviour in medical services.
- Acquire insights into hospital information systems, EHR, interoperability standards, and supportive services.
- Analyze quality assurance frameworks, safety management systems, and accreditation requirements in healthcare organizations.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION **9**

Distinction between Hospital and Industry – Challenges in Hospital Administration – Hospital Planning: Digital Infrastructure Planning, Equipment Planning, Functional Planning – Telemedicine & e-Health Systems – Current Issues in Hospital Management – Bio-Medical Waste & E-Waste Management

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL **9**

Principles and Functions of HRM – Profile of HRD Manager – Tools of HRD – Human Resource Inventory – Manpower Planning – Competency Mapping and Talent Acquisition (new inclusion) – Recruitment, Selection – Training & Development: Digital Training Platforms – Evaluation of Training – Leadership Grooming & Succession Planning – Promotion, Transfer – Communication: Nature, Scope, Barriers, Styles and Modes.

UNIT III MARKETING RESEARCH PROCESS **9**

Marketing Information Systems – Assessing Information Needs – Developing and Disseminating Information – Market Research Process – Digital Health Marketing & Social Media Analytics (new inclusion) – Consumer Markets and Consumer Buyer Behaviour – Models of Consumer & Business Buyer Behaviour – Major Types of Buying Situations – WTO and Its Implications

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES **9**

Management Decisions and Related Information Requirements – Clinical Information Systems – Administrative Information Systems – Support Service Technical Information Systems – Electronic Health Records (EHR) & Interoperability Standards (new inclusion) – Medical Transcription – Medical Records Department – Central Sterilization & Supply Department – Pharmacy – Food Services

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UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality System – Elements, Implementation, Documentation, Quality Auditing – International Standards: ISO 9000–9004. Features of ISO 9001. ISO 14000 – Environment Management Systems – NABA, JCI, NABL – Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules – Hazard & Risk Assessment – Patient Safety Indicators & Clinical Risk Management– Health Insurance & Managing Health Care – Medical Audit.

TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students be able to,

- Differentiate hospitals from industries and explain planning, digital infrastructure, and waste management challenges.
- Apply human resource management concepts including manpower planning, competency mapping, training, and leadership development in hospitals
- Demonstrate knowledge of healthcare marketing strategies, digital marketing tools, social media analytics, and global implications like WTO.
- Evaluate the role of hospital information systems, EHR, interoperability standards, and supportive services for effective hospital operations.
- Assess quality and safety frameworks (ISO, NABH, JCI, NABL), risk management, fire and security protocols, and patient safety indicators in hospitals.

TEXTBOOKS:

1. Goyal R.C., *Hospital Administration and Human Resource Management*. PHI Learning Pvt Ltd, 2017.
2. Kunders G.D., *Hospitals – Facilities Planning and Management*. Tata McGraw Hill, New Delhi, Fifth Reprint, 2007.

REFERENCES:

1. Cesar A Caceres and Albert Zara, *The Practice of Clinical Engineering*, Academic Press, New York 1977.
2. Norman Metzger, *Handbook of Health Care Human Resources Management*, 2nd Edition, Aspen Publication Inc., 1990.
3. Peter Berman, *Health Planning for Effective Management*. Oxford University Press, 1988.
4. Blane & Brunner, *Health and Social Organization: Towards a Health Policy for the 21st Century*. Eric Calrendon Press, 2002.
5. Arnold D. Kalcizony & Stephen M. Shortell, *Health Care Management*, 6th Edition, Cengage Learning, 2011.

WEB RESOURCES:

1. Kotov. Alexander. (2015). Social Media Analytics for Healthcare. 10.13140/RG.2.1.2301.8409.
2. Chen J, Wang Y Social Media Use for Health Purposes: Systematic Review J Med Internet Res 2021:23(5):e17917.

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Mapping of COs with POs and PSOs

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

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BoS/BME 28/10/25

24BM302PE	MEDICAL SAFETY AND QUALITY ASSURANCE	L T P C
		3 0 0 3

OBJECTIVES:

The students should be made to:

- Gain knowledge of safety practices in healthcare delivery systems.
- Understand international and national quality standards for hospitals, laboratories, and medical devices.
- Analyze patient safety strategies and risk management processes.
- Learn quality improvement techniques and audit methodologies in healthcare.
- Develop skills to integrate safety and quality assurance in clinical, diagnostic, and administrative practices.

UNIT I – FUNDAMENTALS OF MEDICAL SAFETY AND QUALITY **9**

Introduction to medical safety – Evolution of safety systems in healthcare – Safety culture and climate in hospitals – Principles of healthcare quality – Dimensions of quality (clinical effectiveness, patient-centeredness, efficiency) – Regulatory requirements in India (CDSCO, NABH, MCI/NMC) and international standards (JCI, ISO).

UNIT II – SAFETY MANAGEMENT IN HEALTHCARE ENVIRONMENTS **9**

Medical hazards in hospitals – Electrical, fire, chemical, and radiation safety – Operating room safety standards – Safety in Intensive Care Units and Emergency Departments – Infection prevention and control – PPE guidelines – Biomedical waste disposal rules – Incident reporting and sentinel events.

UNIT III – QUALITY ASSURANCE FRAMEWORKS **9**

Total Quality Management (TQM) in healthcare – Six Sigma and Lean methods – Clinical audit and quality indicators – Root Cause Analysis (RCA) and Failure Mode Effect Analysis (FMEA) – Accreditation requirements (NABH, JCI, ISO 15189, CAP) – Benchmarking and healthcare key performance indicators.

UNIT IV – QUALITY AND SAFETY IN CLINICAL PRACTICES **9**

Evidence-based medicine – Clinical pathways and protocols – Standard Treatment Guidelines (STGs) – Medication safety and error prevention – Laboratory Quality Management System (LQMS) – Calibration and maintenance of medical equipment – Documentation and record keeping for quality improvement – Patient safety reporting systems.

UNIT V – AUDITS, RISK MANAGEMENT AND CONTINUOUS IMPROVEMENT **9**

Internal and external quality audits – Reliability centered maintenance in healthcare – Risk assessment and mitigation strategies – Patient satisfaction and feedback mechanisms – Continuous quality improvement cycle (PDSA, DMAIC) – Case studies on medical error analysis – Legal and ethical issues in healthcare safety and quality.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students be able to,

- Explain and apply safety practices in healthcare delivery systems to ensure patient and staff safety.
- Interpret and compare international and national quality standards applicable to hospitals, laboratories, and medical devices.
- Evaluate patient safety strategies and perform risk assessment and management in healthcare environments.
- Implement quality improvement tools, techniques, and audit methodologies to enhance healthcare service quality.
- Integrate safety and quality assurance principles into clinical, diagnostic, and administrative operations for effective healthcare management.

TEXTBOOKS

1. Sharon B. Buchbinder & Nancy H. Shanks, *Introduction to Healthcare Quality Management*, Jones & Bartlett, 2019.
2. R. P. Tripathi, *Quality Assurance in Healthcare*, Jaypee Publications, 2019.
3. Charles Vincent, *Patient Safety*, Wiley-Blackwell, 2016.

REFERENCE BOOKS

1. J. M. Juran & Joseph A. Defeo, *Juran's Quality Handbook: The Complete Guide to Performance Excellence in Healthcare*, McGraw Hill, 2016.
2. Avedis Donabedian, *Explorations in Quality Assessment and Monitoring*, Health Administration Press.
3. WHO, *Patient Safety Curriculum Guide: Multi-professional Edition*, World Health Organization, 2017.
4. NABH, *Accreditation Standards for Hospitals*, 5th Edition, Quality Council of India, 2020.
5. ISO 15189:2022, *Medical Laboratories – Requirements for Quality and Competence* for Hospitals, 5th Edition, Quality Council of India, 2020.

Mapping of COs with POs and PSOs

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

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BoS/BME

BME

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24BM303PE	BIO STATISTICS	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the statistical informer methods and Analysis
- Comprehend the fundamentals of mathematical and statistical theory in the biomedical field
- Apply the regression and correlation analysis in the physiological data
- Understand the source of Medical data & applying in community health
- Understand the Meta Analysis of Healthcare data

UNIT I – INTRODUCTION 9

Introduction, Some basic concepts, Measurement and Measurement Scales, Sampling and Statistical Inference, The Scientific Method and the Design of Experiments, Computers and Biostatistical Analysis, Introduction to open-source biostatistics software (R, Python).

UNIT II – PROBABILITY DISTRIBUTIONS 9

Probability Distributions of Discrete Variables, Binomial Distribution, Poisson Distribution, Continuous Probability Distributions, Normal Distribution, Normal Distribution Applications, Introduction to Bayesian probability concepts in biomedical research.

UNIT III – REGRESSION AND CORRELATION ANALYSIS 9

Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient, Logistic regression for binary medical outcomes.

UNIT IV – INTERPRETING DATA 9

Interpreting life tables, clinical trials, epidemical reading and interpreting of epidemical studies, application in community health, Data visualization best practices for healthcare dashboards.

UNIT V – 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, Introduction to mixed-effects models for longitudinal health studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define the new and existing statistical methodology for their research problem
- Explain the values for different statistical tests
- Analyze the biomedical research data and be able to report the study results
- Describe the various sources of medical data
- Demonstrate the meta-Analysis of Healthcare

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TEXT BOOKS:

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.
4. Chandan K. Reddy, Charu C. Agarwal, "Healthcare Data Analytics", CRC Press, 2015.

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.

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM304PE ECONOMICS AND MANAGEMENT FOR ENGINEERS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the Nature, law & Scope of Economics
- Understand the concepts of Economics with respect to the demand and supply analysis.
- Analyze the theory of production and the analysis of the cost parameter
- Explore the concept of management and its approach
- 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 – Nature of Managerial 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, Circular economy concepts and their relevance to engineering projects.

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, Behavioral economics perspective on consumer demand in technology markets.

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, Impact of automation and Industry 4.0 on production cost structures.

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, Agile management methodology overview for engineering projects.

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, Use of AI-driven forecasting tools in strategic planning.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Summarize how to use economics principles to solve economic problems in engineering discipline by satisfying the economic laws
- Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity
- Interpret short run and long run costs in the process of production for carrying out a business
- Apply managerial skills to make decisions and solve problems for achieving organizational objectives
- Express the principles of effective planning for survival and success of all organizations using strategic planning & decision making

TEXT BOOKS:

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. Ranbir Singh, "Principles of Engineering Economics and Management", S.K.Kataria & Sons, New Delhi, 2013.
2. Manish Varshney and Vidhan Banerjee, "Engineering and Managerial Economics", 1st Edition, CBS Publishers and Distributors Pvt. Ltd., 2015.

Mapping of COs with POs and PSOs

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

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BoS/BME

24BM305PE	FORENSIC SCIENCE IN HEALTHCARE	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the history of forensic sciences and concepts of quality control management
- Identify the roles of different types of professionals involved in evaluating a crime scene and the Evidence collection
- Understand the Forensic microscope and Anthropology
- Apply the Blood stain identification
- Learn 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, Organization of forensic science laboratories of center and state - NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions, Digital forensics overview and its integration with healthcare investigations.

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, Use of drones and 3D scanning technology in crime scene documentation.

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, Forensic odontology basics and its role in victim identification.

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, Rapid presumptive tests for bodily fluids using portable devices.

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, Emerging biometric techniques such as palm vein and facial recognition in forensic healthcare.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Define the significance of forensic sciences
- Observe and document crime scenes
- Determine Trauma and Diseases.
- Describe the various sources of medical data related to forensic science.
- Demonstrate the visual analytical procedure of finger print application.

TEXT BOOKS:

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

REFERENCES:

1. "Saferstein : Criminalistics", Prentice Hall Inc., USA, 1976.
2. Peter Deforest, Robert Gaensslen, Henry Lee, "Forensic Science: An Introduction to Criminalistics" Tata McGraw-Hill, 1983.
3. Sharma, B.R. "Forensic Science in Criminal Investigation and Trials", Central Law Agency, Allahabad, 1974.

Mapping of COs with POs and PSOs

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

Chairman
BoS/BME

24BM306PE	CLINICAL ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understanding of the clinical engineering profession, qualifications, roles, activities, and expectations
- Enhance to practice medical equipment and analyze challenges with their healthcare technology
- Engage to work as a team to address problems and errors in medical devices
- Design better medical devices with computerized approaches
- Explore the Health Technology Management systems with medical devices and supportive services with advanced application

UNIT I – INTRODUCTION **9**

Clinical engineering: Definition, Evolution. Roles, Responsibilities, Functional status. History of clinical engineering and Technology in Health Care System, Enhancing patient safety, Role of AI in predictive maintenance of medical devices.

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, Prerequisite for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA, Use of IoT for real-time equipment monitoring.

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, Incorporation of green and sustainable medical technologies in EHTP.

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, Benchmarking clinical engineering performance with global standards.

UNIT V – ADVANCED TECHNOLOGY FOR PATIENT SAFETY **9**

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. Case Studies, Integration of wearable health tech for early patient risk detection.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology
- Give the program and framework to recognize the errors of medical equipment
- State the issues or errors in patient safety and formulate patient safety package system
- Define the problem precisely and examine the possible issues using program indicators
- Demonstrate computer-based equipment with automated system by using CPOE method

TEXT BOOKS:

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

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	2	-	2	2	1	1	2	1
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CO3	2	3	3	2	3	2	-	3	3	2	1	3	2
CO4	2	2	3	2	3	2	-	3	3	2	1	3	2
CO5	2	2	3	2	3	2	-	3	3	2	1	3	2

Chairman
BoS/BME

24BM307PE	ENTERPRISE MANAGEMENT	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamental principles of enterprise management and its role in modern industries
- Learn the organizational structure, functions, and decision-making processes within enterprises
- Acquire skills in financial, human resource, and operational management of enterprises
- Familiarize with digital enterprise systems, ERP, supply chain, and innovation management
- Develop the ability to analyze case studies and apply enterprise management concepts in real-world scenarios

UNIT I INTRODUCTION TO ENTERPRISE MANAGEMENT **9**

Definition and Characteristics of Enterprises – Types of Enterprises: Small, Medium, Large – Corporate Culture – Industrial Relations – Role of Manager and Entrepreneur – Challenges in Enterprise Management – Digital Enterprise Concepts – Emerging Trends in Global Enterprises.

UNIT II ENTERPRISE PLANNING AND ORGANIZATION **9**

Principles of Management – Organizational Structure and Design – Authority and Responsibility – Decision Making Process – Strategic Planning – Enterprise Resource Allocation – Business Process Reengineering – Knowledge Management – Business Ethics and Corporate Governance.

UNIT III HUMAN RESOURCE AND FINANCIAL MANAGEMENT **9**

HR Functions in Enterprises – Recruitment, Selection, Training, Performance Appraisal – Leadership and Motivation – Manpower Planning – Compensation and Retention Strategies – Basics of Financial Management – Capital Structure, Budgeting, Cost Control – Project Financing – Risk Analysis.

UNIT IV OPERATIONS AND SUPPLY CHAIN MANAGEMENT **9**

Production and Operations Management – Facility Location and Layout – Materials Management – Inventory Control – Just-in-Time (JIT) – Total Productive Maintenance (TPM) – Supply Chain and Logistics Management – Digital Supply Chains – Quality Management Systems (ISO, TQM, Six Sigma).

UNIT V ENTERPRISE SYSTEMS, INNOVATION AND CASE STUDIES **9**

Enterprise Resource Planning (ERP) – Customer Relationship Management (CRM) – Decision Support Systems – Business Analytics – Innovation and Technology Management – Start-up Ecosystem and Entrepreneurship – Case Studies of Successful Enterprises (Healthcare, IT, Manufacturing).

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the structure, functions, and challenges of enterprise management in different industrial contexts.
- Apply principles of planning, organizing, and decision-making for enterprise success.
- Demonstrate knowledge of HR and financial management strategies for effective enterprise operations.
- Analyze operations and supply chain management techniques, including digital applications and quality systems.
- Evaluate enterprise systems (ERP, CRM, analytics) and innovation strategies through real-world case studies.

TEXTBOOKS:

1. Koontz, H. & Weihrich, H., *Essentials of Management: An International and Leadership Perspective*, 10th Edition, McGraw Hill Education, 2015.
2. Panneerselvam, R., *Production and Operations Management*, 3rd Edition, PHI Learning Pvt. Ltd., 2012.
3. Gupta, C.B., *Management: Theory and Practice*, 19th Edition, Sultan Chand & Sons, 2019.

REFERENCE BOOKS:

1. Robbins, S.P. & Coulter, M., *Management*, 14th Edition, Pearson Education, 2018.
2. Chary, S.N., *Production and Operations Management*, 5th Edition, McGraw Hill Education, 2017.
3. Laudon, K.C. & Laudon, J.P., *Management Information Systems: Managing the Digital Firm*, 16th Edition, Pearson Education, 2020.
4. Stevenson, W.J., *Operations Management*, 14th Edition, McGraw Hill Education, 2020.
5. Dess, G.G., Lumpkin, G.T., Eisner, A.B. & McNamara, G., *Strategic Management: Creating Competitive Advantages*, 9th Edition, McGraw Hill Education, 2021.

Mapping of COs with POs and PSOs

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CO4	2	2	3	2	3	2	-	3	3	2	1	3	2
CO5	2	2	3	2	3	2	-	3	3	2	1	3	2

Chairman
BoS/BME

24BM308PE **ORGANIZATIONAL BEHAVIOUR** **L T P C**
3 0 0 3

The student should be made to:

- Understand foundational concepts of organizational behaviour, perception, and learning theories
- Explore personality theories and attitude formation in workplace contexts
- Examine emotional dynamics and motivational processes in organizational settings
- Investigate interpersonal relationships, leadership styles, and team dynamics in diverse organizational contexts
- Understand organizational culture, structural dimensions, and change management processes

UNIT I INTRODUCTION AND PERCEPTION AND LEARNING **9**

Defining organization, behavior and organizational behaviour – assumptions of OB – principles of OB – levels of OB – scope of OB – OB and Human Resource Management – Applications of OB – Historical developments of OB – emerging concerns, understanding perception – Basic elements of perception – Principles of perceptual selection – Perceptual grouping – Social Perception – Self-perception and identity – attribution of causality – Perceptual biases in social perception – Implications for human resource management – defining learning – classical and operant conditioning – learning in organizations, Impact of remote work on organizational behaviour and learning patterns.

UNIT II PERSONALITY AND ATTITUDES **9**

Defining Personality – History of the concept – Key assumptions – biological and social determinants – Theories: Intrapsychic theory, social learning theory, self-theory, Trait and type theories – Related concepts (locus of control, dogmatism, authoritarianism, Machiavellianism) – measuring personality. Definition – Key elements of attitudes – Attitudes and related concepts (Values, opinion, belief and ideology) – Characteristics of attitudes – Attitude formation – Attitude measurement – Changing attitudes – Attitudes at workplace (job satisfaction, work attitude and organizational commitment) – Prejudice and discrimination at workspace, Emotional intelligence assessment and its role in leadership.

UNIT III EMOTIONS IN WORKPLACE AND MOTIVATION **9**

Definition – Types of emotions – Related concepts (mood, temperament) – Stress in workplace – General Adaptation Syndrome – Managing Stress – Psychosomatic disorders and stress – emotional labor and emotional contagion. Definition – Process of motivation – Types of motives – Motivators at workplace – Motivation theories (Process and Content theories), Gamification techniques for employee motivation.

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UNIT IV INTERPERSONAL DYNAMICS, POWER AND LEADERSHIP, TEAM DYNAMICS 9

Definition – Psychological Contract – Trust and trust building – Prosocial behaviour – Cooperation Vs Competition – Conflict management – Levels and types of conflict at workplace – Conflict management Styles – Managing Negotiations – Defining Power – Sources of Power – Organizational politics – Leadership – Managers Vs Leaders – Trait and Type approach to leadership – Leadership style – Leadership Grid – Contingency Theories – Contemporary issues – Groups and Teams – Types of Teams – Stages in group development – problems in team work (Free riding, social loafing, group think) – Cross-cultural virtual teams. Leading hybrid and virtual teams effectively.

UNIT V ORGANIZATIONAL CULTURE, CHANGE, STRUCTURE AND DESIGN 9

Defining culture – levels of culture – cultural dimensions – high and low context cultures – Strong and weak organizational cultures – Expressions of organizational culture – Impact of culture on individuals – Organizational cultural change – Change in Organizations – Nature of the change process – Types of change – Impact of change – Managing resistance to change – Organizational Development interventions – Basic dimensions of structure – Departmentalization – Organizational life cycle – Organizations as socio-technical systems – Organizational design and its impact on employees – Organizational boundary spanning, Agile organizational structures for rapid change management.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the principles of organizational behaviour and analyze the impact of perception and remote work on learning in organizations
- Evaluate the role of personality traits and emotional intelligence in shaping workplace attitudes and leadership
- Apply motivation theories and stress management techniques to enhance employee engagement and well-being
- Analyze conflict management strategies and assess leadership effectiveness in hybrid and cross-cultural teams
- Design agile organizational structures and propose interventions for managing cultural change and resistance

TEXT BOOKS:

1. Udai Pareek, "Understanding Organizational Behaviour", Oxford University Press 3rd Edition.
2. Jerald Greenberg and Robert A. Baron, "Behaviour in Organizations", PHI learning private Ltd, New Delhi, 9th Edition.

REFERENCE:

1. Nelson, Quick and Khandelwal, "Organizational Behaviour", Cengage Learning New Delhi, 2nd Edition.

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Mapping of COs with POs and PSOs

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

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24BM401PE **BIOFLUIDS AND DYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamental principles of biofluid mechanics and their application to human physiology.
- Analyze the mechanical behavior of cells, tissues, and ocular systems using experimental and computational methods.
- Evaluate blood rheology and vessel mechanics in normal and pathological conditions.
- Apply biomechanics concepts to cardio-respiratory systems, aerospace, and space medicine.
- Utilize computational fluid dynamics for modeling and solving biomedical flow problems.

UNIT I BIOFLUID MECHANICS **9**

Intrinsic fluid properties - Density, Viscosity, Compressibility, Surface tension, Hydrostatics Fluid characteristics and viscosity – Displacement and velocity, Sheer stress and viscosity Bernoulli equation, Introduction to pipe flow – Reynolds number, Poiseuille's law, Flow Rate, Womersley number, Constitutive equations – Newtonian fluid, Non-Newtonian viscous fluid, Diameter, velocity and pressure of blood flow relationship, Resistance against flow, Viscoelasticity – Viscoelastic models, Response to Harmonic variation, Use of viscoelastic models, Bio-Viscoelastic fluids – Protoplasm, Mucus, Saliva, Synovial fluids, Microfluidic analogs for modeling physiological flows; emerging biofluid diagnostic tools

UNIT II CELLULAR AND OCCULAR MECHANICS **9**

Cellular Biomechanics – Eukaryotic cell architecture, Cytoskeleton, Cell-matrix interactions, Mechanical property measurement – Atomic Force microscopy, Optical Trapping, Magnetic bead microrheometry, Micropipette aspiration, Models of cellular biomechanical behavior, Computational model of a chondrocyte in its matrix, Mechanotransduction, Techniques for mechanical stimulation of the cells, Tissue cell mechanobiology – Endothelial, smooth muscle cells, Chondrocytes, Osteoblasts, Ocular Biomechanics – Occular anatomy, Biomechanics of Glaucoma, Ocular blood flow, Corneal biomechanics in refractive surgery; computational simulation in ocular fluid dynamics.

UNIT III BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS **9**

Viscometry, Elements of Blood, Blood characteristics – Viscosity of blood, Einstein's equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation,Casson"s equation, Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion, Anatomy and physiology of blood vessels, Arterial wall as membrane – Uniaxial loading, Biaxial loading, Torsion, Hemodynamics of Large arteries – Ventricular outflow and the aorta, Pressure-flow relations and Vascular Impedance, Wave propagation and reflection, Elastography for arterial stiffness measurement; hemodynamic simulations for stent design.

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UNIT IV CARDIO RESPIRATORY MECHANICS AND SPACE MEDICINE 9

Cardiac cycle – Pressure volume diagrams, Changes in contractility, Ventricular performance, Congestive heart failure, Pulsality index, Physics of valvular diseases, Prosthetic heart valves and replacements, Respiratory System – Alveolar ventilation-lung volumes and capacities, Mechanics of breathing, Work of breathing – Lung compliance, Airway resistance, Gas exchange and transport, Oxygen dissociation curve, Lung surfactant, Pulmonary pathologies, Space Medicine – Hypoxia, Physiology of decompressive sickness, Human response to acceleration, Thermal Stress, Countermeasure technologies for spaceflight; respiratory mechanics in high-altitude pilots.

UNIT V COMPUTATIONAL FLUID DYNAMICS 9

Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection-Diffusion Problems, Solution Algorithms for Pressure-Velocity Coupling in steady flows, Solution of Discretized Equations, The Finite Volume Method for Unsteady flows, Implementation of Boundary Conditions Application – Multiphysics computational models for cardiac flow and virtual cardiography, Multiphysics modeling for coupled fluid–structure interaction in the heart and vessels; virtual surgery and patient-specific simulation.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate the ability to explain and apply biofluid mechanics concepts to physiological systems.
- Perform basic analysis of cellular, tissue, and ocular biomechanics using standard measurement techniques.
- Interpret blood rheological data and assess vascular mechanical properties in health and disease.
- Analyze cardio-respiratory and aerospace physiological responses using biomechanical principles.
- Develop and implement CFD models for simulating biomedical flow and fluid–structure interactions.

TEXTBOOKS:

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, "Biofluid Mechanics-The human circulation", CRC Taylor and Francis, 2007.
2. Y.C Fung, "Biomechanics- Mechanical properties of living tissues", 2nd Edition, SpringerVerlag, 1993.
3. Jeffery R. Davis et. Al., "Fundamentals of Aerospace Medicine", Wolter Kluwer Health, Lippincott Williams and Wilkins, 2008

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REFERENCES:

1. 1. Jung HeeSeo, Vijay Vedula, Theodore Abraham and Rajat Mittal, "Multiphysics computational models for cardiac flow and virtual cardiography", Int. J. Numer. Meth. Biomed. Engng. (2013) Published online in Wiley Online Library.
2. 2. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill, 2007.
3. 3. John K-J Li, "Dynamics of Vascular System", World Scientific, 2004.
4. C. Ross Ethier, Craig A Simmons, "Introduction to Biomechanics- From Cells to Organisms", Cambridge Texts in Biomedical Engineering, 2007.
5. 5.H K Versteeg, W Malalasekera, "An Introduction to Computational Fluid Dynamics
6. The Finite Volume Method", Longman Scientific and Technical, 1995.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	–	–	–	–	–	–	–	–	1	2	–
CO2	3	2	1	–	–	–	–	–	1	–	1	2	–
CO3	3	2	2	3	3	–	–	1	1	–	2	3	–
CO4	3	3	1	3	3	–	–	–	2	–	2	3	1
CO5	3	3	2	2	3	1	–	–	1	–	3	3	1

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24BM402PE **BIO - ERGONOMICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand human visual, auditory, and cognitive capabilities for effective ergonomic design
- Analyze muscle physiology, biomechanics, and energy expenditure in work environments
- Apply principles of control–display compatibility and human–machine interface design
- Utilize anthropometric data and ergonomic principles for safe and efficient workspace layout
- Evaluate real-world ergonomic applications through case studies in industrial and biomedical contexts

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, alarm and signal design – integration of visual and auditory channels Measures for monitoring control & mitigation.

UNIT II MUSCLE PHYSIOLOGY **9**

Muscle physiology – muscle metabolism – respiratory response – joint motion study and kinematic analysis – 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 , injury prevention strategies.

UNIT III CONTROLS AND DISPLAYS **9**

Spatial compatibility and cognitive compatibility - physical arrangement of displays and controls - Design of displays and controls – movement capability – human–machine interface considerations - 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- Safety design interventions – ergonomics-based hazard control strategies.

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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. Case Study 3: Motion and time study applications in manufacturing and healthcare service workflows.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply ergonomic principles to optimize visual, auditory, and cognitive aspects of system design
- Assess physical workload, posture, and biomechanical limits to improve worker safety and performance
- Design control–display interfaces that align with human capabilities and operational requirements
- Implement anthropometric data for ergonomic workspace, seating, and equipment layout
- Develop practical ergonomic solutions for industrial and biomedical applications through case studies

TEXT BOOKS:

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.
3. Benjamin W.Niebel, "Motion and Time Study", Richard, D. Irwin Inc., Seventh Edition, 2002.

REFEENCES:

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

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	1	–	–	1	–	2	2	2
CO2	3	3	2	2	3	2	–	–	1	–	2	3	2
CO3	3	3	3	2	3	2	–	–	2	–	3	3	3
CO4	3	3	2	2	3	3	–	–	2	–	3	3	3
CO5	3	3	3	3	3	3	–	1	2	1	3	3	3

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24BM403PE	PHYSIOLOGICAL MODELLING	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamental principles and methods of mathematical modeling in physiological systems
- Develop understanding of dynamic and control behaviors in biological processes through block diagram and system analysis
- Explore nonlinear modeling techniques and their applications in complex physiological functions
- Study compartmental and distributed parameter models for simulating physiological transport and regulation
- Provide hands-on experience in simulating, analyzing, and validating physiological models using computational tools

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. Introduction to feedback regulation in physiological processes – feedforward vs. feedback control in homeostasis.

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. Inclusion of adaptive control concepts as observed in neural reflexes and sensory adaptation.

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. Applications of nonlinear models in cardiovascular dynamics, respiratory mechanics, and endocrine regulation.

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: Thermoregulation, Thermoregulation of cold bloodedness & warm bloodedness, the anatomy of thermoregulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

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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 ,noise modeling and filtering techniques (e.g., Kalman filtering) for physiological signal simulation.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply mathematical modeling techniques to represent and analyze physiological systems
- Evaluate dynamic responses and stability characteristics of biological control systems
- Implement nonlinear modeling methods for complex physiological processes
- Construct compartmental models for physiological transport and regulatory mechanisms
- Simulate and validate physiological models using MATLAB/OpenCV and interpret results for research or clinical applications

TEXT BOOKS:

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.

REFEENCES:

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. David T Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	–	2	–	–	–	–	–	2	3	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	1	–	3	3	3
CO4	3	3	2	2	3	–	–	–	1	–	3	3	3
CO5	3	3	3	3	3	1	–	–	2	1	3	3	3

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24BM404PE MODELING AND DESIGNING OF BONE AND DENTAL IMPLANTS

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Analyze the biomechanical characteristics of bone and implant materials for performance compatibility
- Evaluate the mechanisms of osseointegration and interface behaviour under varied clinical conditions
- Formulate implant design strategies that optimize structural integrity and functional longevity
- Integrate modelling techniques and finite element analysis for predictive implant performance assessment
- Design advanced biomedical implants using innovative materials and manufacturing technologies

UNIT I INTRODUCTION TO BIOMECHANICS OF BONE & IMPLANT MATERIALS 9

Mechanical properties of bone – anisotropy, density, microstructure; classification into cortical and cancellous bone; role in load-bearing function. Biomechanical properties: elastic modulus, hardness, fracture strength, fracture toughness – their influence on implant stability and longevity. Overview of biomaterials used in implants: titanium alloys, zirconia, PEEK, and composite materials. Comparison of mechanical compatibility between bone and biomaterials. Influence of modulus mismatch on bone remodeling and stress distribution.

UNIT II OSSEOINTEGRATION & INTERFACE CONSIDERATIONS 9

Mechanism of osseointegration at the bone–implant interface – biological phases of healing, bone deposition, and remodeling. Factors influencing osseointegration: surface chemistry, topography, and microstructure. Biomechanical implications such as stress shielding and the role of implant stiffness. Effect of surface roughness on bone cell adhesion and mechanical stability. Computational and theoretical models predicting interface performance. Case examples from experimental studies.

UNIT III IMPLANT DESIGN METHODOLOGIES 9

Morphological segmentation of implants into integration zone, neck zone, and restoration zone – their specific roles in stability and load transfer. Geometrical parameters: thread profile, pitch, and taper. Design strategies for mechanical stability, stress resistance, and fatigue life. Platform switching principles and their influence on peri-implant bone preservation. Role of macro-geometry and micro-surface modification in functional integration. Optimization of contact area for osseointegration.

UNIT IV MODELING & FINITE ELEMENT ANALYSIS (FEA) 9

Workflow for 3D modeling of bone–implant assemblies using CAD tools. Meshing strategies and quality criteria for accurate simulation. Application of realistic load simulations in static and dynamic conditions. Evaluation parameters: von Mises stress analysis, strain energy

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density, and micromotion prediction. Verification and validation of FEA models against experimental data. Case studies of 3D finite element modeling for implant design optimization and stress reduction in peri-implant bone.

UNIT V ADVANCED MATERIALS & MANUFACTURING TECHNIQUES 9

Additive manufacturing techniques for dental and orthopedic implants: selective laser melting (SLM), electron beam melting (EBM), and binder jetting. Biomimetic designs for enhancing mechanical compatibility and damage resilience. Hybrid manufacturing approaches combining subtractive and additive processes. Surface treatment for enhanced biological response. Engineering challenges in artificial bone interfaces – modulus mismatch, thermal effects, and fatigue resistance. Future directions: 4D printing, graded porosity structures, and smart implants.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply biomechanical principles to evaluate bone and implant material compatibility.
- Model and analyze bone–implant interactions using finite element methods.
- Design implant geometries for optimal mechanical stability and biological integration.
- Select suitable materials and manufacturing methods for dental and orthopedic implants.
- Assess clinical performance and troubleshoot implant failures through case studies.

TEXT BOOKS:

1. Adriano Piattelli (Ed.), Bone Response to Dental Implant Materials, Woodhead Publishing, 2017.

REFEENCES:

1. Carl E. Misch, Dental Implant Prosthetics, 2nd Edition, Elsevier Health Sciences, 2015.
2. Brunski J.B., Biomechanical Factors Affecting the Bone–Dental Implant Interface, Clinical Materials Journal, Elsevier, 1992.
3. Zarb G.A., Hobkirk J., Eckert S., Jacob R., Prosthodontic Treatment for Edentulous Patients: Complete Dentures and Implant-Supported Prostheses, 13th Edition, Elsevier Health Sciences, 2013.
4. Z. Jin, P. Procter, Finite Element Analysis and Its Applications to Implant Dentistry, Springer, 2010.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	–	2	1	–	–	–	–	2	3	2
CO2	3	3	3	3	3	–	–	–	1	–	3	3	3
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	2	2	3	2	–	–	1	–	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

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24BM405PE **REHABILITATION ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Familiarize the fundamentals of rehabilitation engineering and assistive technologies
- Explore engineering concepts in sensory augmentation and substitution
- Study design and control methods for prosthetics and orthotics
- Examine virtual reality and robotics applications in rehabilitation
- Understand medical, legal, and ethical considerations in rehabilitation practice

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. Classification of rehabilitation technologies.

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). Use of smart materials (shape-memory alloys, lightweight composites), embedded sensors for gait analysis.

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. Immersive VR environments for balance and coordination training, remote VR-based rehabilitation (telerehabilitation)

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. Assistive technology certification standards.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain core rehabilitation principles and technologies
- Design sensory augmentation and substitution systems
- Apply smart materials and sensors in prosthetics/orthotics
- Use VR and robotics for rehabilitation therapy
- Assess legal, ethical, and advocacy aspects in rehab care

TEXT BOOKS:

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

REFEENCES:

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.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	2	1	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	3
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	–	–	–	2	1	3	3	3
CO5	3	2	2	–	2	3	3	1	2	2	3	2	2

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24BM406PE	ASSISTIVE TECHNOLOGY (Common to BME, ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Analyze the principles, operation, and clinical relevance of major biomedical assist devices
- Evaluate technological innovations in cardiac, renal, auditory, and prosthetic systems for improved patient outcomes
- Integrate clinical engineering practices, safety standards, and regulatory guidelines into medical device usage
- Design and propose advanced assistive solutions using emerging biomedical technologies
- Critically assess the role of assistive devices in multidisciplinary healthcare and rehabilitation

UNIT I CARDIAC ASSIST DEVICES 9

Cardiac functions and parameters, principle of External counter pulsation techniques, intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker, ventricular assist devices (VADs) and total artificial hearts (TAH), implantable cardioverter defibrillators (ICDs)

UNIT II HEMODIALYSERS 9

Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyzer monitoring and functional parameters, hemodiafiltration, wearable artificial kidney (WAK), infection control protocols in dialysis units

UNIT III HEARING AIDS 9

Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit. DSP based hearing aids, wireless and Bluetooth-enabled hearing aids, bone-anchored hearing systems (BAHS)

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices, myoelectric control systems, powered exoskeletons.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery, neuroprosthetics and brain–computer interface (BCI) applications, robotic rehabilitation systems.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Demonstrate in-depth understanding of the working principles and clinical applications of assistive biomedical devices
- Apply safety protocols, performance evaluation methods, and maintenance strategies for medical equipment
- Compare and contrast conventional and advanced assistive technologies in terms of efficiency and patient adaptability
- Integrate multidisciplinary knowledge to suggest appropriate device solutions for specific clinical scenarios
- Assess recent trends and innovations for potential adoption in healthcare and rehabilitation practice

TEXT BOOKS:

1. Joseph D. Bronzino, "The Biomedical Engineering Handbook", 3rd 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, 2010.
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, "Clinical Engineering", CRC Press, 1st edition, 2010.

REFEENCES:

1. Kenneth J. Turner, "Advances in Home Care Technologies: Results of the match Project", Springer, 1st Edition, 2011.
2. Gerr M. Craddock, "Assistive Technology-Shaping the future", IOS Press, 1st Edition, 2003.
3. Matthew Dipaola, "3D Printing in Orthopaedic Surgery", Elsevier, 2019.
4. Daniel Goldstein, Mehmet Oz, "Cardiac Assist Devices", Wiley-Blackwell 2000.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	2	1	–	–	1	–	2
CO2	3	3	2	2	3	2	2	–	1	–	2
CO3	3	3	3	2	3	–	–	–	2	–	3
CO4	3	3	3	3	3	2	–	1	2	1	3
CO5	3	3	3	3	3	3	2	1	2	1	3

Chairman
BoS/BME

24BM407PE PHYSIOLOGICAL CONTROL SYSTEMS **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Introduce fundamental control theory concepts applied to physiological systems
- Develop skills in modelling and analysing dynamic responses of biological processes
- Apply stability analysis techniques for evaluating physiological feedback systems
- Integrate time-domain and frequency-domain tools for biomedical system evaluation
- Employ computational simulation methods for studying and predicting physiological control behaviour

UNIT I INTRODUCTION TO CONTROL SYSTEMS & PHYSIOLOGY **9**

Open vs. closed-loop systems, modelling, block diagrams & signal flow graphs, reduction methods, illustration of physiological control systems, linear physiological models, distinction between engineering and physiological control systems.

UNIT II TIME-DOMAIN ANALYSIS **9**

First- and second-order system responses (step, impulse), time-domain specifications, steady-state errors, standard test signals

UNIT III STABILITY & ROOT LOCUS TECHNIQUES **9**

Definition of stability, Routh–Hurwitz criterion, root locus construction and stability assessment

UNIT IV FREQUENCY-DOMAIN ANALYSIS **9**

Frequency response specifications, polar plots, Bode plots, Nyquist plots, Nyquist stability criterion, Nichol's chart, M-N circles

UNIT V PHYSIOLOGICAL CONTROL SYSTEM MODELS **9**

Models of muscle stretch reflex (steady-state, transient), frequency response of circulatory control, pupillary light reflex stability analysis, sugar-level control, endocrine and excretory systems, receptor characteristic models and transfer functions

TOTAL: 45 PERIODS

OUTCOMES:

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

- Model physiological systems using block diagrams, transfer functions, and analogs
- Perform time-domain and frequency-domain analysis to evaluate system response
- Analyze system stability using classical control techniques
- Interpret and model biological feedback control mechanisms
- Use MATLAB/Simulink for simulating physiological control systems

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TEXT BOOKS:

1. Michael C.K. Khoo, Physiological Control Systems: Analysis, Simulation, and Estimation, Wiley-IEEE Press, 2nd Edition, 2018.
2. I. J. Nagarath & M. Gopal, Control Systems Engineering, New Age International, 2018.
3. Salivahanan, S. Rengaraj, & Venkatakrishnan, Control Systems Engineering, Pearson Education India, 2015.

REFERENCES:

1. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
2. Ogata & Y. Yang, Modern Control Engineering, Prentice-Hall, 2002.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	–	2	–	–	–	–	–	2	3	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	1	–	3	3	3
CO4	3	3	2	2	3	–	–	–	1	–	3	3	3
CO5	3	3	3	3	3	1	–	–	2	1	3	3	3

Chairman
BoS/BME

24BM501PE	ARTIFICAL ORGANS AND IMPLANTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Differentiate the design, clinical needs, and evaluation of artificial organs and transplants
- Apply tissue engineering concepts and material selection criteria to propose organ solutions
- Analyze the critical factors influencing implant success, including biocompatibility and degradation
- Explain the operational principles and design challenges of blood-interfacing and neural/neuromuscular implants
- Evaluate the feasibility of various implant solutions and Propose areas for future device innovation

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: 45 PERIODS

Chairman

BoS/BME 28/10/25

OUTCOMES:

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

- Differentiate between the design considerations. clinical needs. and evaluation processes for major artificial organs and transplant procedures.
- Apply tissue engineering concepts and material selection criteria to outline potential organ solutions
- Analyze the critical factors influencing long-term implant success. including biocompatibility. local/systemic effects. and degradation mechanisms.
- Explain the operational principles and key design challenges of blood-interfacing implants and common neural/neuromuscular devices
- Evaluate the feasibility of implantable solutions across various systems and propose areas for future device innovation

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.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	1	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman
BoS/BME

24BM502PE	TELEMEDICINE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Explain telemedicine fundamentals, scope, and limitations
- Differentiate communication and networking technologies for medical data types
- Apply multimedia standards to implement store-and-forward and real-time operations
- Analyze data security, ethical, and legal requirements in telemedicine
- Appraise the architecture and clinical utility of specialized telemedicine systems

UNIT I INTRODUCTION TO TELEMEDICINE **9**

History of Telemedicine, Block diagram of telemedicine system, Definition of telemedicine, Tele health, Tele care, origins and Development of Telemedicine, Scope, Benefits and limitations of Telemedicine.

UNIT II ROLE OF COMMUNICATION SYSTEMS IN TELEMEDICINE **9**

Types of information: Audio, Video, still Images, text and data, Fax. Types of Communication and Network: PSTN, POTS, ATN, ISDN, Internet, Wireless Communications: GSM, satellite and Micro Wave. Different modulation techniques, Types of antennas depending on requirements. Integration and Operational issues: system integration, Store-and-forward operation, realtime Telemedicine.

UNIT III MULTIMEDIA IN TELEMEDICINE **9**

Data Exchanges: Network Configuration, Circuit and packet switching, H.320 series (Video phone-based ISBN) T.120, h.324 (Video phone based PSTN), Video Conferencing.

UNIT IV SECURITY ISSUES IN TELEMEDICINE **9**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, Phases of Encryption. Photocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7. Ethical and legal aspects of Telemedicine: Confidentiality and Law, patient rights and consent, access to medical Records, Consent treatment, jurisdictional Issues, Intellectual property rights.

UNIT V TELEMEDICINE SYSTEMS **9**

Tele radiology: Basic parts of Teleradiology system: Image Acquisition system, Display system, Communication network, Interpretation. Tele Pathology: Multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of colour, Controlled sampling, security and confidentiality tools. Tele cardiology, Teleoncology, Telesurgery.

TOTAL: 45 PERIODS

Chairman

BoS/BME 28/10/25

OUTCOMES:

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

- Explain telemedicine system block diagram, benefits, and limitations
- Differentiate roles of communication systems in transmitting medical data
- Apply multimedia standards and protocols to plan telemedicine operations
- Analyze security and legal/ethical protocols in telemedicine
- Appraise the architecture and clinical utility of specialized systems

TEXT BOOKS:

1. Bernard Fong, A. C. M. Fong and C. K. Li, "Telemedicine Technologies: Information Technologies in Medicine and Digital Health", Wiley; 2nd edition, 2020
2. A.C.Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.

REFERENCES:

1. R.S.Khandpur, "Telemedicine: Technology and Applications" PHI Learning, 2017
2. Richard Wootton, John Craig and Victor Patterson, "Introduction to Telemedicine", CRC Press, Second Edition, 2006
3. RifatLatifi et.al., "Telemedicine, Telehealth and Telepresence: Principles, Strategies, Applications, and New Directions", Springer, 2020
4. Olga Ferrer-Roca, M.SosaLudicissa, Handbook of Telemedicine, IOS press 2002.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	1	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	2	2	3	3	3	1	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman
BoS/BME

24BM503PE	PATTERN RECOGNITION AND EXPERT SYSTEMS IN MEDICINE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Have an insight about the different types of pattern classification techniques
- Explain the concepts of structures, strategies and searching techniques in artificial intelligence
- Describe and use the concepts of knowledge representation and reasoning in AI application
- Describe about types and methods of learning
- Analyze about the application of AI in medical field and use feature extraction based on clustering

UNIT I CLASSIFICATION OF PATTERNS 9

Classes, Patterns and features, Pattern similarity and PR tasks, Pattern discrimination, Feature space metrics and covariance matrix, Feature selection and extraction methods, Statistical, Syntactic and descriptive approaches, Bayesian classification, Bayes rule for minimum risk, Minimum error rate classification, Discriminant functions and decision surfaces, Linear discriminant functions

UNIT II INTELLIGENCE AND SEARCHING 9

Artificial Intelligence components, Problem definition, Problem solving agents, State Space search, Uniformed search - Depth first and breadth first search, DFS with iterative deepening, Informed heuristic search, A Algorithm, AND OR graphs, Searching with partial information-online search agents and unknown environments.

UNIT III KNOWLEDGE AND REASONING 9

Logical Agents, Propositional Calculus, Syntax and Semantics of First order logic, Forward and Backward chaining, Resolution-Theorem proving problems using resolution, AI Representational schemes semantic nets, conceptual graphs using frames and scripta, Production system, Rule based expert system

UNIT IV LEARNING TYPES AND METHODS 9

Classes, Forras of learning, inductive learning, Decision trees, Learning using relevance information, Statistical learning methods-EM algorithm, Intelligence using neural networks, Reinforcement learning-Passive and Active reinforcement.

UNIT V APPLICATIONS IN MEDICINE 9

Unsupervised clustering, K means clustering, Fuzzy C means clustering, AI in diagnosis ELISA model, Biometrics in e-health security, Face recognition, Gene matching, Automated drug delivery systems, Mining of Electronic Health record, Tumor boundary detection Interactive control of colour, Controlled sampling, security and confidentiality tools, Tele cardiology, Teleoncology, Telesurgery.

TOTAL: 45 PERIODS

Chairman

BoS/BME

OUTCOMES:

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

- Classify different types of pattern recognition. feature extraction
- Identify and apply Al components to search techniques and problem solving
- Describe the knowledge of Agents. schemes and rule base followed for periods
- Explain the types decision trees and learning methods
- Interpret and apply the learned concepts in the medical field for diagnosis and metrics.

TEXT BOOKS:

1. Stuart Jonathan Russel. Peter Norvig. "Artificial Intelligence: A Modem Approach". Pearson Education. Third Edition. 2013.

2. George F Luger. "Artificial Intelligence Structures and Strategies for Complex Problem Solving". Pearson Education. Fourth Edition. 2002.

REFERENCES:

1. Rochard O Duda and Hart PE and David G Stork. "Pattern classification". John Wiley and Sons Inc. Second Edition. 2001.

2. Carlo Combi. Yuval Shahar. "Artificial Intelligence in Medicine - 12 Conference. Springer. 2001.

3. Svetlana N. Yanushkevich. Image Pattern Recognition Synthesis and Analysis in Biometrics Vol 67. World Scientific. 2007.

4. Anke Meyer Base. "Pattern Recognition for Medical Imaging". Elsevier. First Edition. 2004.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	–	2	–	–	–	1	–	2	3	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman
BoS/BME

24BM504PE	VIRTUAL BIOINSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Grasp the fundamentals and history of virtual instrumentation
- Develop skills in using LABVIEW, including its environment and programming structures
- Comprehend digital I/O techniques and data acquisition methods
- Learn about different communication protocols and interfaces used in VI
- Explore practical applications of VI in biomedical instrumentation, such as ECG and EMG acquisition, and virtual reality modeling

UNIT I INTRODUCTION TO VIRTUAL INSTRUMENTATION 9

Virtual instrumentation (VI): Evolution, Definition, Architecture; Conventional and Distributed VI; Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques; graphical programming, Comparison between graphical programming and conventional programming; VI in engineering process.

UNIT II PROGRAMMING MODES IN VI 9

VI: front panel, block diagram; LABVIEW Environment: Start up, Shortcut, and Pull down menu, Pallets; Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes; Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters; Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

UNIT III HARDWARE ASPECTS OF VI SYSTEM 9

Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers; data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software

UNIT IV COMMON INSTRUMENT INTERFACE 9

Current loop: 4-20mA, 60mA, RS232, RS422, RS485, General purpose interface bus(GIPB); Virtual Instrument Software Architecture (VISA); Universal serial port bus(USB); Peripheral computer interface (PCI); VME extensions for instrumentation (VXI); PCI extensions for Instrumentation (PXI); Personal Computer Memory Card International Association (PCMCIA); Signal conditioning extension for instrumentation (SCXI).

UNIT V ANALYSIS TOOLS AND APPLICATIONS OF VI 9

Fourier transform, Power spectrum, Correlation, Windowing, Analog-to-Digital & Digital-to-Analog Conversion; Sampling, noise and filtering, Oscilloscope, Waveform generator, multi-channel data acquisition using LABVIEW, ECG acquisition for long term monitoring of heart rate using VI, Electromyography (EMG), Air Flow and Lung Volume, Virtual Reality & 3D graphical modelling.

TOTAL: 45 PERIODS

Chairman

BoS/BME 28/10/25

OUTCOMES:

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

- Articulate the evolution. definition. and architecture of virtual instrumentation
- Create and interpret block diagrams and data flow techniques in VI
- Apply digital I/O techniques and configure hardware for data acquisition in LABVIEW
- Explain and use different communication protocols and interfaces such as RS232. USB. PCI. VXI. PXI. and others in VI systems
- Implement practical VI applications such as ECG and EMG monitoring. lung volume measurement. and create virtual reality models for Biomedical Engineering

TEXT BOOKS:

1.Gary Jonson. "Labview Graphical Programming". Second Edition. McGraw Hill. New York. Fourth edition 2006.

2 Jerome. Jovitha. Virtual Instrumentation using Labview. India. PHI Learning. 2010.

REFERENCES:

1. Lisa K wells & Jeffrey Travis. "Labview for everyone". Prentice Hall Inc. New Jersey. First edition 1997.

2. Gupta S J. Gu.pta P. "PC interfacing for Data Acquisition & Process Control". Instrument Society of America. Second Edition. 1994.

3. Technical Manuals for DAS Modules of Advantech and National Instruments.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	–	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman

BoS/BME

24BM505PE	BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS (Common to BME and ECE)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand types of BCI, principles and its applications which are present in the State of art in the Neurosciences domain
- Illustrate the various control signals used in BCI
- Demonstrate the signal processing methods used in BCI
- Assess the various machine learning methods of BCI
- Learn the various applications of BCI

UNIT I INTRODUCTION 9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non-Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECG, MEG, fMRI..

UNIT II BRAIN ACTIVATION 9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials – Visual Evoked Potentials P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT III FEATURE EXTRACTION METHODS 9

Data Processing Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence

UNIT IV MACHINE LEARNING METHODS 9

Classification techniques Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression -Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.

UNIT V APPLICATIONS 9

BCIs for Assistive Technology – BCIs for Recreation - BCIs for Cognitive Diagnostics and Augmented Cognition, Brain-Computer Interfacing and Games – Introduction - Human-Computer Interaction for BCI - BCI for Controlling and Adapting Games Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cortical control of muscles via functional electrical stimulation. Non-invasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing

TOTAL: 45 PERIODS

Chairman
BoS/BME 28/10/25

OUTCOMES:

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

- Develop an understanding towards BCI types and compare various acquisition modalities
- Identify and apply signals for BCI control
- Explore and identify appropriate feature extraction methods
- Apply suitable machine learning algorithms for BCI decision making/control
- Propose different BCI's for a variety of applications

TEXT BOOKS:

1. Rajesh P.N. Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, 1st edition, 2013.
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction, Springer, 2010.
3. Jonathan Wolpaw and Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practice, Oxford University Press, USA, 1st edition, 2012.

REFERENCES:

1. Ella Hassianien A and Azar A.T (Editors), Brain-Computer Interfaces Current Trends and Applications, Springer, 2015.
2. Ali Bashashati, MehrdadFatourechi, Rabab K Ward and Gary E Birch, A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals, Journal of Neural Engineering, Vol (4), 2007, PP: 32-57.
3. Wolpaw J.R, N. Birbaumer et al, Brain control interface for Communication and control, Clinical Neurophysiology, 113, 2002

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	1	-	-	1	-	2
CO2	3	3	3	2	3	1	-	-	1	-	2
CO3	3	3	3	3	3	-	-	-	1	-	2
CO4	3	3	3	3	3	1	-	-	1	-	3
CO5	3	3	3	2	2	2	1	1	2	1	3

Chairman
BoS/BME

24BM506PE	SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Explain speech production mechanics and psychoacoustic principles
- Differentiate the analysis-synthesis frameworks of various filter banks and transform.
- Apply standard coding techniques to audio signal compression problems
- Analyze time and frequency domain parameters of speech using techniques like Short-Time Fourier and Homomorphic analysis
- Evaluate Linear Predictive Coding (LPC) methods and Design LPC-based vocoders

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.

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BoS/BME 25/10/25

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Examine auditory models to design perceptual audio quality measure
- Design analysis-by-synthesis model for speech perception
- Analyze and design algorithms for speech and audio coding
- Analyze and design algorithms for extracting parameters from the speech signal
- Implement pitch detection and formant analysis in speech signals

TEXT BOOKS:

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. London. Moscow. 2002.
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.
5. Sklar. B. "Digital Communication Fundamentals and Applications" Pearson Education. 2nd Edition. 2007.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	–	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman

BoS/BME

24BM507PE	DEEP LEARNING AND DEPLOYMENT OF AI MODELS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Explain Deep Learning fundamentals, Neural Networks, and classic CNN models
- Design modern CNN architectures and implement vision tasks using TensorFlow
- Analyze RNN architectures, gradient issues, and the use of Attention Mechanisms for sequence problems
- Evaluate model performance using metrics and Optimize training with tuning and regularization techniques
- Appraise deployment strategies and implement the use of containerization tools for the AI model lifecycle

UNIT I INTRODUCTION TO DEEP LEARNING 9

Overview of AI, machine learning, and deep learning- Neural networks basics: Perceptron, activation functions- Understanding CNN architecture: convolutional layers, pooling layers, fully connected layers - Classic CNN models: LeNet, AlexNet, VGG, ResNet.

UNIT II CONVOLUTIONAL NEURAL NETWORKS (CNNs) 9

Convolutional Neural Networks(CNN) – Architecture (INCEPTION, Efficient net) – Accelerating Training with Batch Normalization- Building a Convolutional Network using Tensor Flow- Object Detection (YOLO, SSD) – Semantic Segmentation (U-Net) –Visualizing Filters and Feature Maps.

UNIT III RECURRENT NEURAL NETWORKS (RNNs) 9

Introduction to RNNs– RNN Architecture and Back propagation Through Time – Vanishing and Exploding Gradients – Long Short-Term Memory (LSTM) Networks – Gated Recurrent Units (GRUs) – Encoder-Decoder Architectures – Sequence-to-Sequence Models – Attention Mechanisms – Tensor Flow Primitives for RNN Models – Practical Applications (NLP, Time Series Forecasting).

UNIT IV TRAINING AND TUNING OF DEEP LEARNING MODELS 9

Data preprocessing: normalization, augmentation, and splitting datasets- Loss functions and optimization algorithms: cross-entropy, mean squared error, SGD, Adam- Techniques to improve model performance: dropout, batch normalization, early stopping- Model evaluation metrics: accuracy, precision, recall, F1-score, ROC-AUC- Hyper parameter tuning: grid search, random search, and Bayesian optimization.

UNIT V DEPLOYMENT STRATEGIES FOR AI MODELS 9

Overview of AI model deployment: importance and challenges- Different deployment strategies: edge, cloud, and on-premises deployment- Lifecycle of an AI model: from development to deployment - Introduction to containerization and orchestration (Docker, Kubernetes)- Setting up and using Docker and Kubernetes for deployment- Other deployment platforms: AWS, Google Cloud, Microsoft Azure.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Demonstrate a thorough understanding of deep learning concepts and architectures
- Design, train, and evaluate deep neural networks for various applications
- Implement advanced neural network architectures such as RNNs and GANs
- Deploy AI models using containerization and orchestration tools
- Utilize specialized hardware accelerators for AI deployment

TEXT BOOKS:

1. Wei Di, Anuragh Bharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
2 Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O Reilly Media, 2017.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning",MIT Press, 2016.
2. Suraj Sawant, "Deep Learning", IGI Global, 2018.
3. https://www.coursera.org/specializations/deep-learning

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	–	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman
BoS/BME

24BM508PE	EXERCISE AND SPORTS BIOMECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Explain biomechanical research basics, mechanical analysis, and qualitative vs. quantitative methods
- Apply linear and angular kinematics principles and utilize open-source software (Kinovea) for data collection
- Analyze kinetic principles and utilize advanced tools/software (MOKKA) for kinematic measurement
- Evaluate the operational function of kinetic measurement tools (Force platforms, Pressure Sensors) and Electro goniometry
- Design a comprehensive biomechanical assessment framework integrating Electromyography (EMG) with kinetic and kinematic data

UNIT I FUNDAMENTALS OF BIOMECHANICAL RESEARCH & ANALYSIS 9

Introduction to the course. Basics of Biomechanical Research. Basics of Mechanical Analysis (Part 1 & 2). Introduction to Kinematics & Kinetics. Types of Analysis: Qualitative & Quantitative. Introduction to Qualitative & Quantitative Analysis.

UNIT II PRINCIPLES OF KINEMATICS AND DATA ACQUISITION 9

Quantitative analysis: Measurement issues and Data collection. Linear Kinematics. Angular Kinematics. Understanding the open-source software (Kinovea).

UNIT III PRINCIPLES OF KINETICS AND ADVANCED KINEMATIC TOOLS 9

Linear Kinetics. Angular Kinetics. Tools for Measuring Kinematic Variables: Timing devices, Video recording devices, Accelerometers, Optical imaging system. Understanding the open-source software (MOKKA).

UNIT IV KINETIC MEASUREMENT TOOLS AND BIOMECHANICAL PARAMETERS 9

Tools for measuring kinetic variables: Force platforms (with practical implication), Force transducers, Pressure Sensors. Methods of Measuring Center of Gravity (CG) in the Human Body. Electro goniometry.

UNIT V INTEGRATED ANALYSIS AND COURSE REVIEW 9

Electromyography (EMG) with kinetic and kinematic measurements for real-world applications.

TOTAL: 45 PERIODS

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BoS/BME 28/10/25

OUTCOMES:

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

- Explain biomechanics fundamentals. defining Kinematics. Kinetics. and various analysis types
- Apply Linear and Angular Kinematics and utilize Kinovea for practical movement analysis
- Analyze movement using Linear and Angular Kinetics and utilize MOKKA for advanced measurement
- Evaluate the function and utility of Force platforms. Force transducers. and Electro goniometry
- Create an integrated methodology for full-body assessment combining EMG with kinetic and kinematic data

REFERENCES:

1. McGinnis. P. M. (2013). Biomechanics of sport and exercise. Human Kinetics.
2.Hall. S. J. (2011). Basic biomechanics (6th ed.). McGraw-Hill Education.
3. Robertson. D. G. E. (2013). Research methods in biomechanics (2nd ed.). Human Kinetics.

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	–	–	–	1	–	2	2	2
CO2	3	3	2	2	3	–	–	–	1	–	2	3	2
CO3	3	3	3	2	3	–	–	–	2	–	3	3	3
CO4	3	3	3	3	3	1	–	–	2	1	3	3	3
CO5	3	3	3	3	3	2	–	1	2	1	3	3	3

Chairman
BoS/BME

24BM601PE VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the foundational components and technologies of VR systems
- Analyze and apply modeling techniques in VR development
- Evaluate usability, safety, and ethical considerations in VR content design
- Compare and contrast computing architectures for VR rendering
- Explore and assess real-world applications of VR across domains

UNIT I INTRODUCTION OF VIRTUAL REALITY **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, Clinical Applications of VR/AR in Surgery, Rehabilitation, and Patient Care.

UNIT II VR DEVELOPMENT PROCESS **9**

Geometric modeling - kinematics modeling- Anatomical Modeling- behaviour modeling - Simulation and Visualization Techniques-surface deformities, 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 - Ethical and Legal Issues in VR/AR Healthcare Applications, Evaluation and Validation of VR-Based Medical Training Systems.

UNIT IV COMPUTING ARCHITECTURE FOR VR **9**

Rendering pipeline, PC graphics architecture, Workstation based architecture-The Sunblade 1000 architecture, The SGI Infinite reality architecture, Distributed VR Architecture-Multipipeline synchronization, Colocated rendering pipeline, Distributed virtual environment.

UNIT V APPLICATIONS **9**

Medical applications-military applications-robotics applications- Advanced Real time Tracking Educational and Training Applications- games, movies, simulations, Therapy, Smart Healthcare and Oil Exploration and Well management Applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the three I's of VR and identify input/output devices used in clinical VR applications
- Demonstrate geometric, anatomical, and behavioral modeling for healthcare simulations
- Critically assess cyber sickness risks and ethical/legal implications in VR-based medical training
- Differentiate between PC-based, workstation-based, and distributed VR architectures
- Illustrate VR use cases in medicine, military, robotics, and smart healthcare systems

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BoS/BME

TEXT BOOKS:

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 Schmalzier & 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.

5. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition, 2014.

6. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015.

Mapping of COs with POs and PSOs

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

Chairman
BoS/BME

24BM602PE	WEARABLE SYSTEMS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamentals and components of wearable systems
- Analyze sensor technologies and power requirements for wearable devices
- Evaluate wireless health systems and Body Area Networks (BANs)
- Explore smart textile technologies and fabrication methods
- Assess real-world applications of wearable systems across domains

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, ECG and Heart Rate Monitoring Sensors, Impedance plethysmography, pneumography, Wearable Blood Pressure Monitoring 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, Wireless Charging Methods, Nanogenerator-Based Energy Harvesting

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, Energy Efficiency in BAN Systems, Interoperability and Standards in BANs, 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, Nano-Coated Textiles, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration, Body Temperature Monitoring.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Remote Patient Monitoring, Rehabilitation and Physiotherapy Monitoring, Gait analysis, Sports Medicine.

TOTAL:45 PERIODS

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OUTCOMES:

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

- Identify key types, components, and applications of wearable systems in healthcare and monitoring
- Compare different biosensors and energy harvesting methods used in wearable systems
- Assess BAN architecture, security, and interoperability challenges in wireless health monitoring
- Describe fabrication techniques and apply smart textile concepts to biological parameter monitoring
- Illustrate use cases in diagnostics, rehabilitation, sports medicine, and remote patient care

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013
3. Edward Sazonov and Micheal Neuman, WearableSensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R.Yuce and JamilY. Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012

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.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	-	1	1	-	-	1	-	1
CO2	3	3	2	1	2	1	-	-	1	-	2
CO3	3	3	2	2	2	3	-	-	2	1	2
CO4	3	2	3	1	3	1	-	-	1	-	2
CO5	2	2	3	-	1	2	1	1	2	2	2

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BoS/BME

24BM603PE	MEDICAL INFORMATICS (Common to BME and IT)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the foundational concepts and structure of medical informatics
- Analyze the role of computers in clinical laboratories and medical imaging
- Explore the architecture and functionality of computerized patient records
- Evaluate computer-assisted decision-making models in clinical settings
- Investigate emerging trends and technologies in medical informatics

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Electronic Health Records (EHR) and Telemedicine, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Clinical Decision Support Systems (CDSS), 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-Computer assisted medical imaging- nuclear medicine, ultrasound imaging, Digital Pathology and Image Analysis, computedX- ray tomography, Radiation therapy and planning, Artificial Intelligence in Medical Diagnosis, 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, Cloud Computing in Healthcare, Clinical information system, Decision Support for Prescribing and Medication Management.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neurocomputers 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, Wearable Health Monitoring Systems, Computers in the care of critically ill patients, Virtual Reality and Rehabilitation Technologies, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer Assisted surgery, Surgical simulation, Telemedicine - Telesurgery, Mobile Health (mHealth)Applications, Medical education and healthcare information, Artificial Intelligence in Medical Education, computer assisted instruction in medicine.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Define key components of medical informatics and explain the role of EHR, HIS, and CDSS in healthcare
- Examine automated diagnostic methods and evaluate AI applications in medical imaging and pathology
- Describe CPR components and apply cloud and intranet technologies in clinical information systems
- Assess expert systems, neural networks, and semantic models used in medical decision support
- Illustrate applications of VR, telesurgery, mHealth, and AI in medical education and patient care

TEXT BOOKS:

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

REFERENCE:

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

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	2	2	3	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-
CO4	3	3	3	3	2	2	3	-	-	-	-
CO5	2	2	2	2	2	2	3	-	-	2	2

Chairman
BoS/BME

24BM604PE	TELEHEALTH TECHNOLOGY (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the evolution, ethical, and legal dimensions of telemedicine
- Analyze telemedical technologies and communication infrastructure
- Evaluate standards and protocols for secure telemedical data exchange
- Apply mobile telemedicine tools for clinical data management
- Explore applications and business models of telemedicine in healthcare

UNIT I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine – Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia – Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications. Communication infrastructure for telemedicine – LAN and WAN technology, Satellite communication, Mobile communication.

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to be followed: DICOM, HL7, H.320 series Video Conferencing. Security and confidentiality of medical records, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology: Image Acquisition system, Display system, Tele pathology. Medical information storage and management for telemedicine: patient information, medical history, test reports, medical images. Hospital information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine – health education and self-care. Introduction to robotic surgery, Telesurgery, Telecardiology, Tele oncology, Telemedicine in neurosciences. Business aspects – Project planning and costing, Usage of telemedicine.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the history of telemedicine and explain ethical, legal, and regulatory issues in global and Indian contexts
- Identify multimedia principles and evaluate various communication networks used in telemedicine
- Compare encryption mechanisms and assess compliance with standards like DICOM, HL7, and ISO-OSI

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- Demonstrate the use of tele-radiology and tele-pathology systems for patient data storage and retrieval
- Discuss telemedicine applications in various specialties and evaluate project planning and cost aspects

TEXT BOOK:

1.Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

REFERENCES:

1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006

2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.

3. Ferrer-Roca, O., Sosa – Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.

4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.

5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997

6. Mohan Bansal " Medical Informatics", Tata McGraw-Hill, 2004.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	-	-	3	3	-	2	-	1
CO2	3	3	2	2	3	1	-	-	1	-	1
CO3	3	3	2	2	3	3	-	-	1	-	2
CO4	2	2	3	1	3	1	-	-	2	-	1
CO5	1	1	1	-	-	2	-	1	3	3	2

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BoS/BME

24BM605PE	BODY AREA NETWORKS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the architecture and challenges of Body Area Networks (BAN)
- Analyze hardware components and power sources used in BAN systems
- Explore wireless communication protocols and network topologies
- Evaluate coexistence and security issues in BAN environments
- Investigate real-world applications of BAN in healthcare and rehabilitation

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 – Standardization efforts – Emerging trends in digital healthcare and IoMT

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. Bluetooth Low Energy (BLE), Ultra-Wideband (UWB).

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, Authentication, encryption-Self-protection and resilience.

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, Smart Prosthetics – Remote rehabilitation- Integration with AI, Cloud computing and Big data for healthcare analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Define BAN and explain its role in healthcare, including technical and security challenges
- Compare low-power MCUs, antenna types, and energy sources for sensor nodes in BAN applications
- Describe RF propagation and apply IEEE standards (e.g., BLE, Zigbee, UWB) in BAN design
- Assess interference types, regulatory frameworks, and secured protocols for resilient BAN systems
- Illustrate BAN use cases in chronic disease monitoring, smart prosthetics, and AI-integrated analytics

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TEXT BOOKS:

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, 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

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	3	-	-	1	-	1
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CO3	3	3	3	1	3	1	-	-	1	-	2
CO4	3	3	2	2	2	3	-	-	1	1	3
CO5	2	2	3	-	2	2	1	1	2	2	2

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BoS/BME

24BM606PE COMMMUNICATION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the principles of analog modulation and signal representation
- Analyze receiver architectures and noise characteristics
- Apply information theory concepts to source and channel coding
- Evaluate bandpass signaling schemes and detection techniques
- Design and assess error control coding for modern communication standards

UNIT I ANALOG MODULATION 9

Basics of Signal Representation, Amplitude Modulation - AM, DSBSC, SSBSC, VSB – Angle Modulation – PM and FM- Modulators and Demodulators, Non- Linear effect in AM and FM.

UNIT II RECEIVER CHARACTERISTICS 9

Noise source and types – Noise figure and noise temperature – Noise in cascaded systems – Single tuned receivers – Super heterodyne receivers. Phase Locked Loop (PLL) based Receivers.

UNIT III INFORMATION THEORY 9

Measure of information – Entropy – Source coding theorem – Discrete memoryless channel-lossless, deterministic, Noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon Fano coding, Huffman Coding, Run length coding, LZW algorithm. Introduction to Data Compression Standard.

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 – Principle of QAM – Structure of non- coherent receivers – BFSK, DPSK, Orthogonal Frequency Division Multiplexing- Principle and Application

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), Application of coding in 4G/5G/6G standards.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain AM, FM, PM techniques and describe modulators/demodulators and non-linear effect
- Evaluate noise sources and receiver types including PLL and superheterodyne systems
- Calculate entropy, mutual information, and apply coding algorithms like Huffman and LZW
- Compare BPSK, QPSK, QAM, and OFDM in terms of BER, PSD, and receiver structures
- Implement block, cyclic, and convolutional codes and assess their role in 4G/5G/6G systems

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TEXT BOOKS:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press, 3 rd Edition, 2007
2. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", TMH, 3rd Edition, 2007
3. 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.

Mapping of COs with Pos and PSOs

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

Chairman
BoS/BME

BME

24BM607PE	BIO - TRANSPORT PROCESSES	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the foundational principles of transport phenomena in biology
- Analyze momentum transport mechanisms in physiological and engineered systems
- Apply mass transport principles to biological and clinical contexts
- Evaluate heat transport processes and thermal modeling in biomedical devices
- Investigate advanced applications of transport phenomena in healthcare

UNIT I – INTRODUCTION TO TRANSPORT PHENOMENA 9

Transport in biological systems – Conservation of mass, momentum, energy – Dimensional analysis, similarity principles, non-dimensional numbers (Re, Pe, Sc, Sh, Bi) – Rheology of biological fluids – Governing equations (Navier–Stokes, Fick, Fourier) – Continuum mechanics – Computational modeling basics.

UNIT II – MOMENTUM TRANSPORT 9

Newtonian & non-Newtonian models (Power law, Casson, Carreau) – Pulsatile blood flow, Womersley number – Boundary layer, entrance length – Flow in porous media (Darcy's law) – Shear stress & endothelial response – Fluid mechanics in artificial organs – Microcirculation – Bio-microfluidics – Lab-on-Chip.

UNIT III – MASS TRANSPORT 9

Molecular diffusion & convection – Fick's laws – Osmosis, dialysis, ultrafiltration – Passive/active transport – Membrane permeability – Mass transfer in porous media – Oxygen/nutrient transport – Tumor microenvironment – Mass transfer with chemical reaction – Pharmacokinetics & compartmental modeling.

UNIT IV – HEAT TRANSPORT 9

Conduction, convection, radiation – Bio-heat equation (Pennes' model) – Thermal regulation & perfusion – Thermal properties of tissues – Heat exchangers in biomedical devices – Cryopreservation & vitrification – Hyperthermia, ablation, laser heating – Numerical modeling (FEM/FDM).

UNIT V – ADVANCED APPLICATIONS 9

Transport in tissue engineering & regenerative medicine – Nanoparticle transport in drug delivery & imaging – Respiratory & renal transport – Pharmacodynamics – Organ-on-chip – Wearable & implantable biosystems – AI/ML in transport modeling – Case studies: tumor microenvironment, hemodynamics, thermal therapy.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain conservation laws, non-dimensional numbers, and governing equations relevant to biological systems
- Compare Newtonian and non-Newtonian models and apply fluid mechanics to artificial organs and microfluidics
- Use Fick's laws and compartmental modeling to evaluate diffusion, osmosis, and pharmacokinetics in tissues.

Chairman
BoS/BME

- Assess bio-heat transfer mechanisms and simulate thermal therapies using FEM/FDM approaches
- Design and evaluate transport models for tissue engineering, drug delivery, and AI-integrated biosystems.

TEXT BOOKS:

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. SaradaSubramanyam, K MadhavanKutty, Singh H D, "Textbook of Human Physiology", S. Chand and Company Ltd, New Delhi, 2012.

Mapping of COs with Pos and PSOs

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

Chairman
BoS/BME

24BM608PE	SENSORS AND ACTUATORS	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the principles of measurement, transduction, and sensor classification
- Analyze the operation and applications of resistive and inductive sensors
- Explore advanced and environmental sensors for smart systems
- Evaluate electromechanical and fluid-based actuators in automotive systems
- Apply smart actuator technologies for temperature control and predictive systems

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

Sensors: Functions- Classifications- Main technical requirement and trends Units and standards, Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error, Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers, Smart sensing principles- MEMS and Nano- Sensors

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSOR 9

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers: - EI pick up and LVDT, Emerging applications in biomedical and structural health monitoring.

UNIT III VARIABLE AND OTHER SPECIAL SENSORS 9

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor. Smart environmental sensors – Biosensors – IoT-enabled sensors – Wearable and implantable sensors.

UNIT IV AUTOMOTIVE ACTUATORS 9

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, 294 relay, stepper motor etc.

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system. Smart actuators with embedded sensing – Adaptive and self-tuning controllers – Integration with IoT for remote monitoring – AI/ML in predictive actuator control.

TOTAL: 45 PERIODS

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BoS/BME 28/10/25

OUTCOMES:

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

- Define sensor functions and classifications, and explain error analysis, calibration, and transducer modeling
- Compare the characteristics and biomedical relevance of strain gauges, thermistors, LVDTs, and piezoresistive sensors
- Describe the working principles of piezoelectric, Hall Effect, and IoT-enabled biosensors for wearable and implantable applications
- Assess actuator types and their integration in electrical machines and control systems for mobility and automation
- Design adaptive controllers and evaluate IoT-integrated actuator systems for remote monitoring and AI-driven control

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.
2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001
3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004.
4. 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. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013.
2. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
3. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd,2003.
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

Mapping of COs with Pos and PSOs

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

Chairman
BoS/BME

24AD101OE	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L T P C
	(COMMON TO AGE, BME, CIVIL, EEE, ECE AND MECH)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the concept of intelligent agents and their interaction with environments
- Explore local search approaches in continuous spaces
- Study knowledge engineering approaches within first-order logic
- Examine planning graphs and their role in efficient planning
- Apply the role of knowledge representation in the learning process

UNIT I INTRODUCTION 9

Intelligent Agents - Agents and environments - good behavior - The nature of environments - Structure of agents - Problem Solving - Problem solving agents - Uniformed search strategies - Avoiding repeated states-Searching with partial information.

UNIT II SEARCHING TECHNIQUES 9

Informed search and exploration - Informed search strategies - heuristic function - Local search algorithms and optimization problems - Local search in continuous spaces - Online search agents and unknown environments - Constraint satisfaction problems (CSP) - Backtracking search and Local search for CSP.

UNIT III KNOWLEDGE REPRESENTATION 9

First order logic - Representation revisited - Syntax and semantics for first order logic - Using first order logic - Knowledge engineering in first order logic - Inference in First order logic - Prepositional versus first order logic - Unification and lifting - Forward chaining - Backward Chaining-Ontological Engineering.

UNIT IV PLANNING 9

Planning problem- Planning with state space search - Partial order planning - Planning graphs - Planning with proportional logic - Time, Schedules, and Resources - Hierarchical task Planning - Conditional Planning - Execution monitoring and re planning - Continuous planning.

UNIT V LEARNING 9

Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning - Logical formulation of learning - Explanation based learning - Learning using relevant information-Statistical Learning Methods - Case Study on AI-Assisted X-Ray Analysis.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (AD)

OUTCOMES:

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

- Apply the concept of problem-solving agents to real-world problem domains
- Implement local search algorithms to solve optimization
- Demonstrate knowledge engineering processes using FOL
- Utilize planning graphs to represent and solve planning tasks
- Analyze the role of knowledge in supporting effective learning

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 4th Edition, 2023.
2. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson Education, 6th Edition, 2021.

REFERENCES:

1. Engene Charniak and Drew Mc Dermott, "Introduction to Artificial Intelligence", Addison Wesley, 2013.
2. Nils J Nilsson, "Principles of Artificial Intelligence", Narosa Publishing House, 2002.
3. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley, Books 3rd Edition, 2000.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	3	1	-	2	2	2	2
CO2	3	2	2	2	3	1	-	1	1	2	2
CO3	3	3	2	2	3	1	-	2	1	2	2
CO4	3	2	3	2	3	1	-	1	2	2	2
CO5	3	2	2	3	3	1	-	2	2	3	3

CHAIRMAN
BoS (AD)

24AD102OE	INTRODUCTION TO DATA SCIENCE	L T P C
	(COMMON TO AGE, BME, CIVIL, EEE, ECE AND MECH)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the fundamental concepts of data science, its lifecycle, and applications
- Acquire, preprocess, and manage different types of data
- Apply probability and statistical techniques for analyzing data
- Develop predictive models using regression analysis
- Analyze networks and social data using graph theory

UNIT I FUNDAMENTALS OF DATA SCIENCE 9

Introduction to Data Science - Data Science Lifecycle - Applications of Data Science in Various Domains - Types of Data: Structured, Unstructured, Semi-Structured - Characteristics of Big Data - Roles in Data Science - Challenges in Data Science - Data Ethics and Privacy Issues - Future Trends in Data Science.

UNIT II DATA COLLECTION AND PREPROCESSING 9

Sources of Data - Data Acquisition Methods - Data Integration and Transformation - Handling Missing Values - Identifying and Removing Duplicates - Data Normalization and Standardization - Outlier Detection and Handling - Exploratory Data Analysis (EDA) - Case Study Using EDA.

UNIT III PROBABILITY AND STATISTICS FOR DATA SCIENCE 9

Introduction to Probability - Probability Distributions - Random Variables - Sampling Methods - Central Limit Theorem - Hypothesis Testing - Confidence Intervals - Correlation and Regression - Statistical Significance - Applications of Statistics in Data Science

UNIT IV REGRESSION ANALYSIS 9

Regression Analysis, Regression: Linear Regression Simple Linear Regression, Multiple & Polynomial Regression, Sparse Model - Unsupervised Learning, Clustering, Similarity and Distances, Quality Measures of Clustering - Case Study.

UNIT V NETWORK ANALYSIS 9

Network Analysis - Graphs - Social Networks - Centrality - Drawing centrality of Graphs - PageRank - Ego-Networks - Community Detection.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (AD)

OUTCOMES:

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

- Perform Exploratory Data Analysis to summarize data and gain insights
- Apply probability, statistical methods, and hypothesis testing to solve data-related problems
- Build and evaluate regression models for prediction and analysis
- Implement clustering techniques and evaluate clustering quality for unsupervised learning tasks
- Analyze complex networks and social graphs using centrality measures, PageRank, and community detection techniques

TEXT BOOK:

1. Foster Provost & Tom Fawcett, "Data Science for Business" 1st Edition, O'Reilly Media, 2013.

REFERENCES:

1. Wes McKinney "Python for Data Analysis" , 2nd Edition, O'Reilly, 2017.
2. Peter Bruce, Andrew Bruce "Practical Statistics for Data Scientists", 2017.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining 2nd Edition, Pearson, 2019.
4. Albert-László Barabási, "Network Science" – Cambridge University Press, 2016.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	1	2	2	-	1	2	3
CO2	3	3	2	3	2	2	2	-	1	2	3
CO3	3	3	3	3	2	2	2	-	-	2	3
CO4	3	3	-	3	3	2	1	-	2	2	3
CO5	2	2	3	2	3	2	1	-	2	2	2

CHAIRMAN
BoS (AD)

24AG101OE	BASICS OF AGRICULTURE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn how biological and environmental factors affect crop growth
- Understand proper plant spacing and nursery techniques for better crop establishment
- Plan and manage water, nutrients, crop protection, fertigation and harvesting effectively
- Identify the main causes of post-harvest losses in cereals, pulses and oilseeds
- Evaluate cleaning and grading equipment based on their efficiency and performance for different crops

UNIT I AGRICULTURE AND CROP PRODUCTION 9

Introduction to agriculture and its crop production sub-sectors – field crop production and Horticulture – Factors affecting crop growth and production: genetic (internal) and environmental (external) factors – Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices.

UNIT II CROP SELECTION AND ESTABLISHMENT 9

Regional and seasonal selection of crops – Systems of crop production – Competition among crop plants – Spacing and arrangement of crop plants – Establishment of an adequate crop stand and ground cover – including selection and treatment of seed and nursery growing.

UNIT III CROP MANAGEMENT 9

Crop water Management – Crop nutrition management – need for supplementation to soil supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients including fertigation scheduling – Integrated methods of managing water, nutrients and plant protection – Types and methods of harvest.

UNIT IV POST HARVESTING 9

Post harvest technology – introduction – objectives – post harvest losses of cereals, pulses and oilseeds – importance – optimum stage of harvest. Threshing – traditional methods mechanical threshers – types - principles and operation - moisture content.

UNIT V CLEANING AND GRADING 9

Principles – air screen cleaners – adjustments – cylinder separator – spiral separator – magnetic separator – colour sorter – inclined belt separator – length separators – effectiveness of separation and performance index.

TOTAL: 45 PERIODS

V. GOPE

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BoS (AGE) 28.10.25

OUTCOMES:

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

- Understand genetic and environmental factors influencing crop growth
- Apply engineering knowledge for crop selection, spacing and cropping system design
- Develop integrated water, nutrient and plant protection management for sustainability
- Solve agricultural problems using research, experiment design and data analysis
- Analyze cleaning and grading equipment based on efficiency and performance indices

TEXT BOOK:

1. Rajendra Prasad, "Textbook of Field Crops Production Volume 1 and 2", Indian Council of Agricultural Research, New Delhi, 2017
2. Reddy S R, "Principles of Agronomy", Kalyani Publishers, New Delhi, 2018
3. Chakraverty A, "Post harvest technology for Cereals, Pulses and oil seeds", Oxford & IBH publication Pvt Ltd, New Delhi, 3rd Edition, 2019

REFERENCES:

1. Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore, 2020
2. Kumar N, "Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants", Oxford and IBH Publishing Co. Pvt. Ltd, 2nd Edition, 2018
3. Rathore N S, Mathur G K and Chasta S S, "Post-Harvest Management and Processing of Fruits and Vegetables", ICAR, The Energy and Resources Institute, India, 2012

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	2	1	-	1	-	-	-	-	-	1
CO5	3	2	1	-	1	-	-	-	-	-	1

CHAIRMAN
BoS (AGE)

24AG102OE	FARM MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the classification of tractors and the operation of tractor engines
- Identify the concepts and functions of various engine systems
- Apply the principles and methods of operation for sowing and fertilizing equipment
- Analyze the types and performance of equipment used for weeding and plant protection
- Examine the working principles and operational efficiency of harvesting machinery

UNIT I TRACTORS 9

Classification of tractors – Tractor engines – construction of engine blocks, cylinder head and crankcase – features of cylinder, piston, connecting rod and crankshaft – firing order combustion chambers - Electronics and Guidance System of Tractor.

UNIT II ENGINE SYSTEMS 9

Valves – inlet and outlet valves – valve timing diagram. Air cleaner – exhaust – silencer. Cooling systems – lubricating systems – fuel system – governor – electrical system.

UNIT III SOWING AND FERTILIZING EQUIPMENT 9

Crop planting – methods – row crop planting systems – Devices for metering seeds – furrow openers – furrow closers – types – Types of seed drills and planters – calibration-fertilizer metering devices – seed cum fertilizer drills – paddy transplanters – nursery tray machines.

UNIT IV WEEDING AND PLANT PROTECTION EQUIPMENT 9

Weeding equipment – hand hoe – long handled weeding tools – dry land star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders. Sprayers – types – classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control.

UNIT V HARVESTING MACHINERY 9

Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Understand tractor engine components, electronics and guidance systems
- Apply knowledge of engine operation, valves and electrical systems
- Operate and maintain sowing and fertilizing equipment through seed/fertilizer metering and calibration
- Evaluate weeding and plant protection equipment based on atomization, droplet size and spray parameters
- Analyze efficiency and performance of harvesting machinery

TEXT BOOK:

1. Jain S C and Rai C R, "Farm Tractor Maintenance and Repair", Standard Publishers and Distributors, New Delhi, 3rd Edition,2 013
2. Jagdishwar Sahay, "Elements of Agricultural Engineering", Standard Publishers Distributors, New Delhi, 2020
3. Michael and Ohja, "Principles of Agricultural Engineering volume-1", Jain brothers, New Delhi, 14th Edition, 2021

REFERENCES:

1. Black P O, "Diesel Engine Manual", D B Taraporevala Sons & Co Pvt Ltd, Mumbai, 1996
2. Kepner RA, "Principles of Farm Machinery", CBS Publishers and Distributers, New Delhi, Kindle Edition, 2018
3. Harris Pearson Smith, "Farm machinery and equipment", Tata McGraw-Hill publication, New Delhi, Kindle Edition, 2017

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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

CHAIRMAN
BoS (AGE)

28.10.25

24CE101OE	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the various characteristics of industrial waste water.
- Interpret the process and mechanism of different wastewater treatment process.
- Infer awareness on waste that emits from industries, waste minimization and clean technologies.
- Demonstrate biological waste water treatment process.
- Make use of treatment of sludge and its disposal methods.

UNIT I INTRODUCTION 9

Undesirable waste water characteristics – Characteristics of industrial waste waters – Waste water characteristics – Estimating the organic content – Measuring the efficiency toxicity – In plant waste control and waste reuse – Storm water control.

UNIT II WASTE WATER TREATMENT PROCESSES 9

Pre and primary treatment of waste water – Equalization – Neutralization – Sedimentation – Oil separation-sour water strippers – Floatation – Coagulation, precipitation and metals removal– coagulation – Heavy metals removal – Aeration and mass transfer; mechanism of oxygen transfer – Aeration equipment – Air stripping of volatile organic compounds.

UNIT III POLLUTION FROM MAJOR INDUSTRIES 9

Sources, Characteristics, waste treatment flow from industries such as Textiles, pulp and paper mill wastes breweries and distilleries waste, Tanneries, Pharmaceuticals, Dairy, Sugar mill wastes, Steel plants, oil Refineries, fertilizer plant waste, petrochemical complex waste, corn starch industry waste –Odour and its removal-removal color from waste waters – Waste minimization and clean technologies.

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UNIT IV **BIOLOGICAL WASTE WATER TREATMENT PROCESS** **9**

Lagoons and stabilization basins – Aerated lagoons-activated sludge processes – Trickling filtration – Rotating biological contactors – Anaerobic decomposition- laboratory evaluation of anaerobic treatment – Adsorption – Theory of activated carbon– Sludge quality considerations – Stripping of volatile organics – Nitrification and denitrification.

UNIT V **SLUDGE TREATMENT AND DISPOSAL** **9**

Characteristics of sludge for disposal – Aerobic digestion – Gravity thickening – Flotation thickening –Rotatary drum screen – Gravity belt thickener – Centrifugation – Vacuum filtration – Pressure filtration – Belt filter press – Sand bed drying-factors affecting dewatering performance – Land disposal of sludges– Incineration.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Summarize undesirable wastewater characteristics with estimation of organic content.
- Explain various methods dealt with treatment of wastewater.
- Utilize waste minimization and clean technologies to reduce pollution
- Apply biological waste treatment process
- Analyze characteristics of sludge for effective sludge treatment and disposal

TEXT BOOKS:

1. Wesley Eckenfelder W, Jr Industrial Water Pollution Control 3rd Edition, Mc–Graw Hill Book Company, New Delhi, 2000.
2. Stephenson R L and Blackburn J B, Industrial Wastewater Systems Hand book, Lewis Publisher, New York, 1998.

REFERENCES:

1. M.N.Rao&A.K.Dutta, Wastewater Treatment, Oxford - IBH Publication, 1995.
2. H.M. Freeman, Industrial Pollution Prevention Hand Book, McGraw-Hill Inc., New Delhi, 1995.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	2	-	-	-	-
CO2	2	3	-	-	2	2	2	-	-	-	-
CO3	2	2	-	-	-	2	2	-	-	-	-
CO4	2	2	-	-	2	2	2	-	-	-	-
CO5	2	2	-	-	2	2	2	-	-	-	-

CHAIRMAN
BoS (CIVIL)

28.10.25

24CE102OE	ECOLOGICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be made to:

- Interpret Principles and Concepts of ecosystem
- Infer the function of ecosystem and its biochemical reaction
- Outline Rehabilitation of ecosystem through ecological Principles
- Organize ecological effects due to industrialization
- Examine the need for environmental sustainability with related case studies.

UNIT I PRINCIPLES AND CONCEPTS 9

Scope- applications of Ecological Engineering - Development - evolution of ecosystems - Principles - concepts pertaining to species - populations - community.

UNIT II ECOSYSTEM FUNCTIONS 9

Biological magnification - diversity - stability - immature - mature systems - Primary productivity - Biochemical cycling of nitrogen - phosphorous - sulphur - carbon dioxide - Habitat ecology - Terrestrial - fresh water - estuarine - marine habitats.

UNIT III ECOLOGICAL ENGINEERING METHODS 9

Bio monitoring - role in evaluation of aquatic ecosystem - Rehabilitation of ecosystems through ecological principles - Step cropping - bio-wind screens - Wetlands - ponds - Root Zone Treatment for wastewater - Reuse of treated wastewater through ecological systems - green building and Bio mimicry.

UNIT IV ECOLOGICAL EFFECTS OF INDUSTRIALISATION 9

Ecological effects of exploration – production- extraction – processing – manufacture - transport - Control of Particulate Emission – Control of Gaseous Emission – Flue Gas Treatment Methods - Stacks Gravitational - Inertial Separation - Settling Chambers -Dynamic Separators - Cyclones - Filtration - Liquid Scrubbing - Electrostatic Precipitators.

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UNIT V CASE STUDIES AND ENVIRONMENTAL SUSTAINABILITY 9

Case studies of integrated ecological engineering systems - Planning -Measuring Sustainability - Carrying Capacity and its limits - Concept of Ecological Foot print.

TOTAL: 45 PERIODS

OUTCOMES:

On Successful completion of this course, the students will be able to:

- Explain the development and evolution of ecosystem.
- Summarize the structure and function of natural ecosystems and biological magnification.
- Utilize ecological engineering principles into sustainable Practices.
- Organize ecological effects of exploration and industrialization.
- Analyze integrated ecological engineering systems.

TEXT BOOKS:

1. Jainul Alam, "Ecological Engineering", Discovery Publishing House, 2025
2. Geoff Gurr, Miguel A Altieri, Steve Wratten, "Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods", CABI Publishing, 2004.

REFERENCES:

1. Majeti Narasimha Vara Prasad, "Handbook of Ecological and Ecosystem Engineering", Wiley; 1st edition,2021.
2. Theodore Sudia, "Ecological Engineering of the City: The Urban Ecosystem", Forgotten Books, 2018
3. Patrick Kangas, "Ecological Engineering: Principles and Practice", CRC Press Inc, 1st edition, 2003.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	2	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	2	2	-	-	-	-	-
CO4	2	2	-	-	2	-	-	-	-	-	-
CO5	2	2	-	-	-	3	-	-	-	-	-

CHAIRMAN
BoS (CIVIL)

24CS101OE	PYTHON PROGRAMMING FOR DATA SCIENCE (Common to AGE, CIVIL, BME, ECE, EEE & MECH)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Familiarize with the data science work environment, including IPython and Jupyter.
- Learn the ndarray object for efficient storage and manipulation of dense data arrays in Python using NumPy.
- Explore the DataFrame object for handling labeled/columnar data in Python using Pandas.
- Perform data visualizations in Python using Matplotlib.
- Apply machine learning algorithms in Python using Scikit-Learn.

UNIT I IPYTHON: BEYOND NORMAL PYTHON 9

Shell and Notebook- Help and Documentation in IPython - Keyboard Shortcuts in the IPython Shell - IPython Magic Commands- Input and Output History - IPython and Shell Commands- Errors and Debugging- Profiling and Timing Code.

UNIT II INTRODUCTION TO NUMPY 9

Understanding Data Types in Python - The Basics of NumPy Arrays - Computation on NumPy Arrays: Universal Functions – Aggregations - Computation on Arrays - Comparisons, Masks, and Boolean Logic - Fancy Indexing - Sorting Arrays - Structured Data.

UNIT III DATA MANIPULATION WITH PANDAS 9

Installing and Using Pandas- Introducing Pandas Objects- Data Indexing and Selection- Operating on Data in Pandas- Handling Missing Data - Hierarchical Indexing- Combining Datasets - Aggregation and Grouping - Pivot Tables - Vectorized String Operations - Working with Time Series - High-Performance Pandas.

UNIT IV VISUALIZATION WITH MATPLOTLIB 9

General Matplotlib Tips - Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plot Legends - Customizing Colorbars - Multiple Subplots - Text and Annotation - Customizing Ticks - Customizing Matplotlib - Three-Dimensional Plotting in Matplotlib - Geographic Data with Basemap - Visualization with Seaborn.

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UNIT V MACHINE LEARNING WITH SCIKIT-LEARN **9**

Machine Learning - Introducing Scikit – Learn - Hyper parameters and Model Validation - Feature Engineering - Naive Bayes Classification - Linear Regression - Support Vector Machines - Decision Trees and Random Forests - Principal Component Analysis - k-Means Clustering - Gaussian Mixture Models - Application: A Face Detection Pipeline.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Leverage IPython and Jupyter for streamlined development and interactive data analysis.
- Utilize NumPy's ndarray for optimized storage and manipulation of numerical data.
- Manage and analyze structured datasets effectively using Pandas DataFrame.
- Design clear and impactful data visualizations using Matplotlib in Python.
- Implement machine learning models in Python using Scikit-Learn for analytical problem-solving.

TEXT BOOK:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2023.

REFERENCE:

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", 3rd Edition, O'Reilly, 2022.
2. John Paul Mueller, Luca Massaron, Wiley, "Python for data science for dummies", 3rd Edition, 2023.

COs – POs Mapping

COURSE OUTCOMES	PO										
	1	2	3	4	5	6	7	8	9	10	11
1	2	2	1	1	3	1	1	1	1	2	1
2	3	3	2	1	3	1	1	1	1	2	1
3	3	3	2	2	3	1	1	1	2	2	1
4	2	2	2	1	2	2	1	1	2	1	1
5	3	3	3	2	3	2	1	1	2	3	2

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26/10/25

24CS102OE	PROGRAMMING AND DATA STRUCTURES (Common to AGE, CIVIL, BME, ECE, EEE & MECH)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Explain the basic concepts, syntax, and flow of C programming.
- Apply advanced features of C for problem-solving.
- Demonstrate the concepts and applications of linear data structures.
- Analyze the representation and use of non-linear data structures.
- Illustrate fundamental techniques in searching, sorting, and hashing.

UNIT I C PROGRAMMING BASICS 9

Structure of C program - Data Types - Storage classes – Variables - Constants - Keywords - Operators - Input/output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays.

UNI II FUNCTIONS, POINTERS AND STRUCTURES 9

Introduction to functions: Function prototype, function definition, function call, Recursion - Pointers - Pointer operators - Pointer arithmetic - Array of pointers - Parameter passing: Pass by value, Pass by reference. Structure - Nested structures - Pointer and Structures - Array of structures - Self-referential structures - Dynamic memory allocation.

UNIT III LINEAR DATA STRUCTURES 9

List -Singly Linked lists - Application of List - Polynomial addition - Linked list implementation of Stacks - Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues - Application of Queue.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees - Binary Trees - Binary tree representation and traversals - Binary Search Trees - Applications of trees. Graph and its representations - Graph Traversals - Topological Sort - Applications of graphs.

C. Saravanan

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UNIT V SEARCHING, SORTING AND HASH TABLE 9

Linear Search - Binary Search. Bubble Sort - Insertion sort - Merge sort - Quick sort - Hashing functions - Hash tables - Introduction to Overflow handling.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Construct programs using the fundamental concepts of C programming.
- Employ advanced features of C to solve computational problems.
- Select and apply appropriate linear data structures for effective problem solving.
- Design and implement non-linear data structures such as trees and graphs for application development.
- Evaluate and compare various searching, sorting algorithms, and hashing techniques.

TEXTBOOK:

1. Reema Thareja, "Data Structures Using C", Third Edition, Oxford University Press, 2023.

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.

COs - POs Mapping

COURSE OUTCOMES	PO										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	2	2	1	-	-	-	1	1	1
2	3	2	3	2	2	-	-	-	1	1	1
3	3	3	3	3	2	-	-	-	1	1	1
4	3	3	3	3	2	-	-	-	1	1	1
5	3	3	3	3	2	-	-	-	1	1	1

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BoS (CSE)

24EC101OE **PRINCIPLES OF SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:
The Student should be made to:

- Understand the basics of signals and systems as a foundation for all engineering-related courses.
- Analyze the fundamental characteristics of Linear Time-Invariant (LTI) systems.
- Gain knowledge of signal transmission requirements and system bandwidth considerations.
- Learn the statistical properties of signals, including correlation and power spectrum concepts.
- Acquire knowledge of noise sources, their characteristics, and impact on system performance.

UNIT I SIGNAL ANALYSIS **9**

Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

UNIT II SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS LINEAR SYSTEM **9**

Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution.

UNIT III SAMPLING THEOREM **9**

Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

UNIT IV TEMPORAL CHARACTERISTICS OF SIGNALS **9**

Concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Time Averages and Ergodicity, Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Cross-Correlation Function and Its Properties, Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function.

UNIT V NOISE SOURCES **9**

Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties.

TOTAL: 45 PERIODS

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BoS (ECE)

OUTCOMES:

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

Understand how to solve the given standard partial differential equations.

- Explain the fundamental concepts of signals, systems, and standard signal functions.
- Apply orthogonal functions, convolution, and correlation techniques to analyze system responses.
- Analyze the characteristics and behavior of Linear Time-Invariant (LTI) systems in time and frequency domains.
- Interpret temporal and statistical properties of signals, including correlation, ergodicity, and power spectral density.
- Identify various noise sources such as thermal, resistive, and arbitrary noise.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, B.S. Publications, Reprint 2017
2. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4 th Ed., 2001.

REFERENCES :

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems," 2nd Ed., Pearson Prentice Hall, 2008.
2. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.
3. Random Processes for Engineers-Bruce Hajck, Cambridge unipress, 2015
4. Statistical Theory of Communication – S.P Eugene Xavier, New Age Publications, 2003

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	1	2
CO2	3	3	2	2	1	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	2	3	-	3	2	-	-	-	-	-	2
CO5	3	2	-	2	1	2	-	-	-	-	2

CHAIRMAN
BoS (ECE)

29/10/25

24EC102OE **CONSUMER ELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Gain knowledge of semiconductor devices, logic circuits, and microcontrollers used in consumer electronics.
- Understand the construction and working of audio, video, and display systems in entertainment electronics.
- Familiarize with the technology and functionality of modern home appliances.
- Learn the concepts, sensors, and technologies involved in smart home automation and security.
- Explore the fundamentals of communication systems and recent advancements such as IoT, Li-Fi, and GPS.

UNIT I ELECTRONIC FUNDAMENTALS **9**

Semiconductor Devices: Diodes, Transistors, Logic gates, Integrated Circuits, -Moor's law, ADC ,DAC, Introduction about Microcontroller, microcontroller in consumer electronics.

UNIT II ENTERTAINMENT ELECTRONICS **9**

Audio systems: Construction and working principle of Amplifier, Microphone, Home Theater-Display Systems: CRT, LCD, LED. Video Players: DVD and blue ray. Camera and camcorders.

UNIT III HOME APPLIANCES **9**

Home Enablement Systems - RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Microwave Owen, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks

UNIT IV SMART HOME **9**

Technology involved in Smart home, Home Virtual Assistants-Alexa and Google Home, Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT V COMMUNICATION SYSTEMS **9**

Cordless Telephones, Fax Machines, PDAs-Tablets, Smart Phones and Smart Watches, Introduction to Smart OS-Android and iOS, Video Conferencing Systems-Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (ECE)

OUTCOMES:

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

- Explain the working principles of semiconductor devices, logic circuits, and microcontrollers in electronic systems.
- Describe the operation of entertainment electronics such as amplifiers, microphones, home theaters, display systems, and video players.
- Identify and explain the technologies used in home appliances including smart refrigerators, induction stoves, and cleaning robots.
- Analyze the technologies and sensors used in smart home systems, virtual assistants, and home security.
- Summarize the working principles of communication systems and discuss the role of IoT, GPS, Wi-Fi, and Li-Fi in modern consumer electronics.

TEXT BOOKS:

1. Bali S P, Consumer Electronics, Pearson Education Asia Pvt. Ltd., 2008
2. Mitchel E Schultz, Basic Electronics, McGraw Hill Publishers, Tenth Edition, 2017.

REFERENCES:

1. Thomas L Floyd, Electronic Devices, Pearson Education Asia, Tenth Edition, 2018
2. Philp Hoff, Consumer Electronics for Engineers, Cambridge University Press, 1998.
3. Jordan Frith, Smartphones as Locative Media, John Wiley, 2014.
4. Dennis C Brewer, Home Automation Made Easy, Que Publishing, 2013.
5. Thomas M Coughlin, Digital Storage in Consumer Electronics, Springer, 2017.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	2	-	-	-	-	1	2
CO2	3	2	-	-	2	-	-	-	-	1	2
CO3	2	2	1	-	2	2	2	-	-	-	2
CO4	2	3	2	2	3	2	2	-	-	-	2
CO5	3	3	2	2	3	2	2	-	-	1	3

CHAIRMAN
BoS (ECE)

24EE101OE	POWER GENERATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The students should be made to:

- Understand the working principles and components of steam power plants
- Explain the operation, classification and governing mechanisms of hydroelectric power plants
- Explore the design, operation, effects and safety measures of nuclear power plants
- Examine the working principles, cycles and recent developments in gas turbine and diesel engine power plants
- Evaluate advanced throwaway and scrubber systems for effective pollution control

UNIT I STEAM POWER PLANTS 9

Introduction – Selection – Steam Flow – Layout – Main Flow Circuits – Main Parts of Steam Power Plant – Cooling of Alternators – Protection of Turbo–Alternators – Excitation and Governing System – Efficiency – Start–up procedure.

UNIT II HYDROELECTRIC POWER PLANTS 9

Introduction – Selection – Hydrology – Classification of hydroelectric plants – Main Components of Hydroelectric Plants – Classification of Hydro Turbines – Hydro Generators – Pump Storage Plants – Governing of water turbine.

UNIT III NUCLEAR POWER PLANTS 9

Introduction – Effects of Fossil Fuels – Selection – Components of Nuclear Power Plant – Main Components of Reactors – Types of Reactors – Effect of Radiation – Nuclear waste and its disposal – Safety of Nuclear Power Reactors.

UNIT IV GAS AND DIESEL ENGINE POWER PLANTS 9

Gas Power plant: Introduction – Simple Gas –Turbine Plant – Open–Cycle and Closed–Cycle Power Generation – Features of Combined Cycle Gas Turbine – IGCC Plants.

Diesel Engine Power plant: Introduction – Advantages and disadvantages – Diesel Engine Power – Equipment – Recent Advances in Diesel Plants.

UNIT V SCRUBBER TECHNOLOGY 9

Introduction – Throwaway system – Methods – Non conventional wet scrubber – Types – Sealing and corrosion – Non–conventional throwaway scrubber – Advantages and disadvantages – FGD systems – Dry scrubbing system – Sludge disposal.

TOTAL : 45 PERIODS

CHAIRMAN
BoS (EEE) 28/10/25

COURSE OUTCOMES:

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

- Explain the working principle and purpose of a steam power plant
- Describe components, processes and efficiency measures for effective plant operation
- Analyze the design, operation, effects and safety measures of nuclear power plants
- Demonstrate knowledge of gas and diesel power plant operation, cycles, equipment and modern advancements
- Assess the effectiveness of advanced throwaway and scrubber systems for pollution control in power generation

TEXT BOOKS:

1. Singh S N, "Electric Power Generation, Transmission and Distribution", Second Edition, PHI Learning Private limited, New Delhi, 2023.
2. Arora S C and Domkundwar S, "Power plant Engineering" Sixth Revised and Enlarged Edition, Dhanpat Rai Publications Private Limited, New Delhi, 2012.

REFERENCES:

1. P K Nag, "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Nagpal G R, "Power Plant Engineering", Khanna Publishers, 2008.
3. El-Wakil M M, "Power Plant Technology", Tata McGraw – Hill Publishing Company Limited, 2010.
4. Rajput R K, "Power Plant Engineering", Laxmi Publications, 2016.
5. Gilbert M Masters, "Renewable and Efficient Electric Power Systems", Second Edition, Wiley, 2013.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	–	–	–	–	–	–	1
CO2	3	3	2	–	–	–	–	–	–	–	1
CO3	3	3	3	–	–	2	–	–	–	–	1
CO4	3	3	2	2	–	–	–	–	–	–	2
CO5	3	2	–	–	–	2	–	–	–	–	1

CHAIRMAN
BoS (EEE)

24EE102OE	ELECTRICAL WIRING AND LIGHTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The students should be made to,

- Understand the fundamentals, classifications and safety regulations of electrical wiring systems
- Learn about protective devices, earthing techniques and safety practices for domestic and industrial installations
- Apply wiring principles to residential, commercial and industrial systems including load calculations and circuit design
- Familiarize with the principles of lighting systems, types of light sources and illumination standards
- Develop skills in designing, estimating, and maintaining wiring and lighting installations

UNIT I FUNDAMENTALS OF WIRING SYSTEMS **9**

Electrical wiring – Need, scope, and classifications. Wiring materials and accessories, Wiring tools and practices – Safety regulations (IE rules & ISI standards). Types of wiring systems: CTS, conduit, casing & capping, cleat wiring and their applications.

UNIT II PROTECTIVE DEVICES AND EARTHING **9**

Fuses, MCBs, ELCBs, RCCBs, and relays – Earthing: pipe earthing, plate earthing, earth electrodes – Importance of earthing and safety measures – Earthing practices in domestic and industrial installations. Protection against overcurrent, overload and leakage.

UNIT III DOMESTIC AND INDUSTRIAL WIRING **9**

Residential building wiring – Single–phase and three–phase systems. Industrial wiring – Bus bar arrangements, distribution boards and industrial accessories. Wiring layout for workshops, factories, and commercial buildings. Design of circuits: load calculation, diversity factor and selection of conductors. Testing of wiring installations.

UNIT IV LIGHTING SYSTEMS **9**

Principles of illumination – Lighting terms: luminous flux, luminous intensity, lux, utilization factor, depreciation factor. Light sources: incandescent, fluorescent, LED, HID lamps. Lighting accessories: ballasts, starters, controls. Indoor and outdoor lighting schemes. Energy–efficient lighting systems and standards.

UNIT V DESIGN, ESTIMATION AND MAINTENANCE **9**

Design of wiring schemes for residential, commercial and industrial installations – Preparation of wiring diagrams and layouts – Estimation of materials and cost for wiring and lighting projects – Maintenance of wiring installations and lighting systems. Fault detection, troubleshooting and preventive maintenance.

TOTAL: 45 PERIODS

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BoS (EEE) 28/10/25

COURSE OUTCOMES:

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

- Describe the types of wiring systems, wiring materials, tools and safety standards
- Apply knowledge of wiring methods to residential, commercial and industrial installations
- Understand the fundamentals of residential, commercial and industrial wiring systems
- Explain lighting principles, light sources, accessories and energy-efficient lighting systems
- Design wiring and lighting installations and perform estimation and maintenance

TEXT BOOK:

1. Uppal S L, "Electrical Wiring, Estimation and Costing", Sixth Edition, Khanna Publishers, 2025.

REFERENCES:

1. Raina K B and Bhattacharya S K, "Electrical Design, Estimating and Costing", Second Edition, New Age International Private Limited, 2017.
2. Gupta J B, "A Course in Electrical Installation Estimating and Costing", Ninth Edition, S K Kataria and Sons, 2022.
3. Giridharan M K, "Electrical Systems Design", Second Edition, I K International Publishing Housing Private Limited, 2016.
4. Sharma Br, "Electrical Estimating and Costing", First Edition, Satya Prakashan Publishers, 2010.
5. National Building Code of INDIA 2016 - Bureau of Indian Standards.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	–	–	2	–	–	–	1
CO2	3	3	–	–	–	–	–	–	–	–	1
CO3	3	2	–	–	–	–	–	–	–	–	2
CO4	3	2	–	–	–	2	–	–	–	–	2
CO5	3	3	3	–	–	–	–	–	–	2	2

CHAIRMAN
BoS (EEE)

24ME101OE	PRODUCTION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Study the classification, properties and applications of engineering materials.
- Provide knowledge of various metal casting processes, equipment and defect analysis.
- Explain the principles and applications of welding, soldering, and brazing processes.
- Familiarize with the basic machining operations of the lathe and various machine tool functions.
- Understand the concepts of Computer Numerical Control (CNC) machine tool.

UNIT I ENGINEERING MATERIALS **9**

Engineering Materials – Classification - Mechanical properties of materials - strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability – Steels and cast irons: Carbon steels, classification based on percentage of carbon as low, medium and high carbon steel – properties and applications. Wrought iron, cast iron – Alloy steels: Stainless steel, tool steel.

UNIT II METAL CASTING PROCESSES **9**

Sand Casting : Sand mould – Type of patterns - Pattern materials – Pattern allowances – Moulding sand properties – Core – Moulding machines – Types and applications; Melting furnaces : Blast and Cupola furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal casting – Stir casting; Defects in sand casting.

UNIT III WELDING **9**

Introduction, classification of welding processes – Gas welding, types of flames and applications – Electric arc welding – Resistance welding – Soldering and Brazing processes and their uses.

UNIT IV MACHINING **9**

Basic principles of lathe – Machine and operations performed on it - Basic description of machines and operations of Shaper, Drilling, Milling and Grinding.

UNIT V CNC MACHINE **9**

Numerical control (NC) machine tools – CNC: types, constitutional details, special features – design considerations of CNC machines for improving machining accuracy - Structural members - Slide ways - Linear bearings - Ball screws - Spindle drives and feed drives.

TOTAL: 45 PERIODS

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(BoS / MECH) 28/10/25

OUTCOMES:

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

- Classify engineering materials based on their properties and applications.
- Explain various metal casting processes, associated equipment and analyze casting defects.
- Apply the principles of welding, soldering and brazing processes in suitable applications.
- Perform basic machining operations using machine tools such as lathe, shaping, drilling, milling, and grinding.
- Explain the concepts and operations of Computer Numerical Control (CNC) machine tools for customized operations

TEXT BOOKS:

1. Kalpakjian and Schmid ,"Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2014
2. Hajra Choudry S.K, "Elements of Workshop Technology - Vol II", Media promoters & publishers Pvt. Ltd, 13th Edition, 2010

REFERENCES:

1. Jain R.K., "Production Technology: Manufacturing Processes, Technology and Automation", Khanna publication India, 17th Edition , 2011
2. P N Rao, Manufacturing technology, Volume I, Foundry, Forming and Welding, McGraw Hill Education (India) Private Limited, 5th Edition , 2018
3. P N Rao, Manufacturing technology, Volume II, Metal Cutting and Machine Tools, McGraw Hill Education (India) Private Limited, 4th Edition , 2018

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	2	2	1	1	2	-	-	-	-	-	1

CHAIRMAN
(BoS / MECH)

24ME102OE	ALTERNATIVE ENERGY FUELS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand various conventional and non-conventional energy sources.
- Learn liquid fuel production processes from coal and related resources.
- Gain knowledge on the working principles and types of fuel cells.
- Identify the processes, properties, and applications of biodiesel.
- Study about electricity generation from nuclear energy.

UNIT I INTRODUCTION TO ENERGY **9**

World energy consumption – petroleum – natural gas – coal – nuclear energy – geothermal energy – renewable energy - solar, wind, tidal, biomass and hydropower.

UNIT II LIQUID FUELS **9**

Introduction to coal pyrolysis – char oil energy development process – TOSCOAL process – Lurgi-Ruhr gas process – Occidental flash pyrolysis process – Clean coke process – Coalcon process.

UNIT III FUEL CELLS **9**

Introduction – basic concepts – design characteristics – operation – thermal efficiency – cell voltage – fuel cell system – general description – fuel cell classifications – low temperature fuel cells - proton exchange membrane fuel cells and alkaline fuel cells – high temperature fuel cells - molten carbonate fuel cells and solid oxide fuel cells.

UNIT IV BIODIESEL **9**

Introduction – transesterification process for biodiesel manufacture – pretreatment of oil – transesterification reaction in a biodiesel reactor – product and by-product separation – purification – properties of biodiesel – cetane number – calorific value – general physical properties of biodiesel – cold flow properties – material compatibility.

UNIT V NUCLEAR ENERGY **9**

Nuclear fission and nuclear reactor physics – electricity generation from nuclear reactors – nuclear fuel cycle – types of reactors – advanced reactors and concepts – hydrogen production – nuclear waste disposal – nuclear fusion.

TOTAL: 45 PERIODS

CHAIRMAN
(BoS / MECH) 28/10/25

OUTCOMES:

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

- Classify various conventional and non-conventional energy resources.
- Understand the different coal-based liquid fuel production processes.
- Explain design and working of different fuel cells.
- Use biodiesel with various blends to evaluate its fuel properties.
- Utilize the nuclear reactors and related energy technologies for sustainable developments.

TEXT BOOKS:

1. Sunggyu Lee, James G Speight, "Handbook of Alternative Fuel Technologies", CRC Press, Taylor & Francis Group, 2014.
2. Arumugam S Ramadhas, "Alternative Fuels for Transportation", Taylor & Francis, 2016.

REFERENCES:

1. Donald L Klass, "Biomass for Renewable Energy, Fuels and Chemicals", Elsevier-Academic Press, 1st Edition.
2. Sunggyu Lee, "Alternative Fuels", CRC Press, Taylor & Francis, 1st Edition.
3. Suresh M, Rajkumar S, Lakshminarayanan A K, "Alternative Energy Sources, Materials and Technologies", Trans Tech Publications Limited, 2015.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	2	-	-	-	-	-
CO4	2	2	-	-	-	2	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-

CHAIRMAN
(BoS / MECH)

28/10/24

24IT101OE FUNDAMENTALS OF SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The Student should be made to:

- Understand various software engineering life cycle models to real-world projects.
- Perform software requirements analysis and develop clear, structured specifications.
- Acquire knowledge of system analysis and design concepts.
- Understand software testing strategies, maintenance approaches, and quality assurance practices.
- Explore project management techniques, including scheduling using modern tools.

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT **9**

Introduction to Software Engineering - Software Process - Perspective and Specialized - Process Models - Introduction to Agility - Agile Process - Extreme Programming - XP Process.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION **9**

Requirement Analysis and Specification - Requirements Gathering and Analysis - Software Requirement Specification - Formal System Specification - Finite State Machines - Petri Nets - Object Modeling using UML: Use Case Model - Class Diagrams - Interaction Diagrams - Activity Diagrams - State Chart Diagrams - Functional Modeling - Data Flow Diagram.

UNIT III SOFTWARE DESIGN **9**

Software Design: Design Process - Design Concepts - Coupling - Cohesion - Functional Independence - Design Patterns: Model View Controller - Publish - Subscribe - Adapter - Command - Strategy - Observer - Proxy - Facade - Architectural Styles - Layered - Client Server - Tiered - Pipe and Filter- User Interface Design.

UNIT IV SOFTWARE TESTING AND MAINTENANCE **9**

Testing: Unit Testing - Black box testing - White box Testing - Integration and System Testing - Regression Testing - Debugging: Program Analysis - Symbolic Execution - Model Checking - Case Study.

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UNIT V PROJECT MANAGEMENT **9**

Software Project Management - Software Configuration Management - Project Scheduling - DevOps: Motivation - Cloud as a Platform - Operations - Deployment Pipeline: Overall Architecture Building and Testing - Deployment - Tools - Case Study.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Compare and select appropriate Software Development Lifecycle Models
- Evaluate project management approaches as well as cost and schedule estimation strategies.
- Perform formal analysis on software specification.
- Use UML diagrams effectively for system analysis and design.
- Design software systems using architectural styles and design patterns.

TEXT BOOKs:

1. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, 1st Edition, McGraw-Hill, 2014.
2. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering: Using UML, Patterns and Java. 3rd Edition, Pearson Education, 2009.

REFERENCES:

1. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd Edition, PHI Learning Pvt. Ltd., 2010.
2. Len Bass, Ingo Weber and Liming Zhu, - DevOps: A Software Architect's Perspective, Pearson Education, 2016.
3. Rajib Mall, Fundamentals of Software Engineering, 3rd Edition, PHI Learning Pvt. Ltd., 2009.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	2	2	1	2	2	-	-	-	1	1	2
2	3	3	2	3	2	-	-	-	2	3	2
3	3	3	2	2	1	-	-	-	2	3	2
4	2	3	2	1	3	-	-	-	2	3	2
5	2	3	1	1	2	-	-	-	-	-	1

CHAIRMAN
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28/10/25

24IT102OE **WIRELESS SENSOR NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the concepts of wireless sensor networks.
- Get exposure on WSN environment.
- Know the layered approach in sensor networks.
- Understand the use of suitable protocol for WSN.
- Explore knowledge on performance analysis of WSN.

UNIT I INTRODUCTION TO WIRELESS SENSOR NETWORKS **9**

Data Communications - Networks - Networks Types - Network Models: TCP/IP Protocol suite - The OSI Model. Digital-to-Digital Conversion: Line coding - Line Coding Schemes - Transmission Modes - Transmission media: Guided - Unguided media.

UNIT II WSN ARCHITECTURE **9**

Data Dissemination - Flooding and Gossiping - Data Gathering Sensor Network Scenarios - Optimization Goals and Figures of Merit - Design Principles for WSNs - Gateway Concepts - Need for Gateway - WSN and Internet Communication - WSN Tunneling.

UNIT III MEDIA ACCESS CONTROL **9**

Fundamentals of MAC protocols - Low Duty Cycle Protocols and Wakeup Concepts - Contention Based Protocols - Schedule-based Protocols - SMAC - BMAC - Traffic -Adaptive Medium Access Protocol - IEEE 802.15.4 MAC Protocol.

UNIT IV TRANSPORT LAYER **9**

Circuit Switching - Packet Switching - Concept of IPV4 - IPV6 - 6LOWPAN and IP - IP based WSN - 6LOWPAN based WSN - IOT.

UNIT V TOOLS FOR WSN **9**

TinyOS: Introduction - NesC - Interfaces - Modules - Configuration - Programming in TinyOS using NesC - TOSSIM - Contiki - Structure - Communication Stack - Simulation environment - Cooja simulator - Programming.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explore the fundamentals of wireless sensor network models.
- Explore knowledge in devising layers in WSN.
- Able to design energy efficient WSNs.
- Design application dependent suitable for infrastructure-less networks.
- Implement various protocols in TinyOS and Contiki.

TEXT BOOKs:

1. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks. 1st Edition, John Wiley & Sons, New Jersey, 2011.
2. Jun Zheng, Abbas Jamalipour, Wireless Sensor Networks: A Networking Perspective. 1st Edition, Wiley-IEEE Press, 2014.

REFERENCES:

1. Waltenegus W. Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice. 1st Edition, John Wiley & Sons, 2014.
2. Ian F. Akyildiz, Mehmet Can Vuran, Wireless Sensor Networks. 1st Edition, John Wiley & Sons, 2011.
3. Zach Shelby, Carsten Bormann, 6LoWPAN: The Wireless Embedded Internet. 1st Edition, John Wiley & Sons, 2009.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	3	2	-	-	-	-	-	-	-
2	3	2	3	2	-	3	-	-	-	-	-
3	3	3	3	3	-	3	3	-	2	2	-
4	3	3	3	3	-	3	3	3	2	2	2
5	3	3	3	3	3	3	-	-	2	2	-

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BoS (IT)

24AD201OE	BASICS OF VISUALIZATION TOOLS	L T P C
	(COMMON TO AGE, BME, CIVIL, EEE, ECE AND MECH)	3 0 0 3

OBJECTIVES:

The student should be made to:

- Gain a comprehensive understanding of the core concepts in data visualization
- Learn the operational principles of different information visualization tools
- Identify and address common issues encountered in data representation
- Master the use of Tableau for effective data visualization
- Develop expertise in creating real-time, interactive visualization systems

UNIT I INTRODUCTION **9**

Context of data visualization - Definition, Methodology, Visualization design objectives - Key Factors - Purpose, visualization function and tone, visualization design options - Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tool - Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs

UNIT II VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES & GRAPHS **9**

Mapping - Time series - Connections and correlations - Indicator-Area chart - Pivot table - Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods - Hierarchies and Recursion - Networks and Graphs - Displaying Arbitrary Graphs-node link graph - Matrix representation for graph s - Info graphics

UNIT III TEXT AND DOCUMENT VISUALIZATION **9**

Acquiring data - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder ,Asynchronous Image Downloads, Web Techniques, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV INTERACTIVE DATA VISUALIZATION **9**

Drawing with data - Scales - Axes - Updates, Transition and Motion - Interactivity - Layouts - Geo-mapping - Exporting, Framework - D3.js, Tableau Dashboards.

UNIT V SECURITY IN DATA VISUALIZATION **9**

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization - Attacking and defending visualization systems - Creating secured visualization system.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply mathematics and basic science knowledge for designing information visualizing System
- Collect data ethically and solve engineering problem in visualizing the information.
- Implement algorithms and techniques for interactive information visualization
- Conduct experiments by applying various modern visualization tool and solve the space layout problem
- Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams

TEXT BOOKS:

1. Robert Spence, "Information Visualization an Introduction", Third Edition, Pearson Education, 2014.
2. Colin Ware, "Information Visualization Perception for Design", Third edition, Margon Kaufmann Publishers, 2012.
3. Robert Spence, "Information Visualization Design for Interaction", Second Edition, Pearson Education, 2006.
4. Benjamin B. Bederson and Ben Shneiderman, "The Craft of Information Visualization", Morgan Kaufmann Publishers, 2003.

REFERENCES:

1. Thomas Strothotte, "Computational Visualization: Graphics, Abstraction and Interactivity", Springer, 1998.
2. Matthew O. Ward, George Grinstein, Daniel Keim, "Interactive Data Visualization: Foundation, Techniques and Applications", Second Edition, A. K. Peters/CRC Press, 2015.
3. Joerg Osarek, "Virtual Reality Analytics", Gordon's Arcade, 2016.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	3	1	-	1	2	2	2
CO2	2	3	3	2	3	3	-	2	2	3	2
CO3	3	3	3	3	3	2	-	1	2	2	2
CO4	3	3	3	3	3	2	-	2	2	1	3
CO5	3	3	2	2	3	2	-	3	3	2	3

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BoS (AD)

28.10.24

24AD202OE	FOUNDATIONS OF MACHINE LEARNING	L T P C
	(COMMON TO AGE, BME, CIVIL, EEE, ECE AND MECH)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand mathematical foundations relevant to machine learning (linear algebra, statistics, VC dimension, PAC learning)
- Grasp different supervised learning algorithms, their assumptions, strengths, and weaknesses
- Learn how ensemble methods and unsupervised learning work and when they are useful
- Understand neural networks in depth: from basic architecture to deep learning practices, and the challenges involved
- Design, perform, and analyse machine learning experiments properly, including model evaluation and statistical comparison

UNIT I INTRODUCTION TO MACHINE LEARNING **9**

Review of Linear Algebra for machine learning - Introduction and motivation for machine learning - Examples of machine learning applications - Vapnik-Chervonenkis (VC) dimension - Probably Approximately Correct (PAC) learning - Hypothesis spaces - Inductive bias - Generalization - Bias-variance trade-off.

UNIT II SUPERVISED LEARNING **9**

Linear Regression Models - Least squares, single & multiple variables - Bayesian linear regression - gradient descent. Linear Classification Models: Discriminant function - Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model - Naive Bayes - Maximum margin classifier - Support vector machine - Decision Tree - Random Forests.

UNIT III 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 IV NEURAL NETWORKS **9**

Multilayer perceptron - activation functions - network training - gradient descent optimization - stochastic gradient descent - error backpropagation from shallow networks to deep networks - Unit saturation (aka the vanishing gradient problem) - ReLU - hyperparameter tuning - batch normalization - regularization; dropout.

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UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS 9

Guidelines for machine learning experiments; Cross Validation (CV) and resampling - K-fold CV, bootstrapping - measuring classifier performance - assessing a single classification algorithm and comparing two classification algorithms - *t* test, McNemar's test, K-fold CV paired *t* test.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the concepts of hypothesis spaces, inductive bias, generalization, and bias-variance trade-off in machine learning.
- Implement linear regression, logistic regression, SVM, decision trees, and random forests, and evaluate their performance.
- Apply unsupervised learning techniques like K-means and Gaussian mixture models and use ensemble methods (bagging, boosting, stacking).
- Design neural network models, tune hyperparameters, apply regularization methods, and handle training issues like vanishing gradients.
- Plan and conduct experiments using cross-validation, bootstrapping; compare classifier performance using statistical tests like *t* test and McNemar's test.

TEXT BOOK:

1. Tom M. Mitchell, "Machine Learning", First Edition, McGraw-Hill Education, Latest Reprint 2023.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", Fourth Edition, MIT Press, 2020.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 2nd Edition, MIT Press, 2023.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Third Edition, O'Reilly Media, 2023.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Second Edition, Springer, 2023 (Corrected reprint).
5. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, Latest Reprint 2024.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	2	1	2	1	2	2
CO2	2	3	3	3	2	2	1	2	1	2	2
CO3	2	3	3	3	2	2	2	2	2	2	2
CO4	2	2	3	3	2	1	2	2	2	2	1
CO5	1	2	2	2	3	1	2	2	2	2	1

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24AG201OE	INTRODUCTION TO ORGANIC FARMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Explain the basic concepts, principles and components of organic farming
- Demonstrate the use of organic nutrient sources
- Implement organic pest and disease management using botanical pesticides
- Compare crop management practices in organic and conventional farming
- Evaluate quality standards, certification and marketing of organic products

UNIT I INTRODUCTION TO ORGANIC FARMING **9**

Organic farming: Introduction – Concepts and principles of organic farming – Components of organic farming – Types of farming – Cropping systems and its types.

UNIT II SOURCES OF NUTRIENTS IN ORGANIC FARMING **9**

Input management; Organic manure – FYM / Rural compost and city composts – Oil cakes – Animal wastes – Vermicompost – Green manure – Green leaf manure – Other nitrogen contributing plants – Biofertilizers.

UNIT III ORGANIC PEST AND DISEASE MANAGEMENT **9**

Different types of pests and their classification – Botanical pesticides and its types – Integrated pest management – Inorganic pesticides, disadvantages of their use – Control of pests and diseases of important crops / vegetables.

UNIT IV ORGANIC CROP MANAGEMENT **9**

Introduction to organic crop management – Organic vegetable crop management – Organic field crop management – Organic plantation crop management – Organic meat production.

UNIT V QUALITY OF ORGANIC PRODUCTS **9**

Quality of organic food – Natural resources of antioxidants for health care – Antioxidants capacity of fruits and vegetables – Organic food and Human health – Organic standards – Organic certification process – Operation structure of organic certification – Marketing of organic products.

TOTAL: 45 PERIODS

V. Gopal

CHAIRMAN
BoS (AGE) 28.10.25

OUTCOMES:

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

- Understand the principles of organic farming for sustainable agriculture
- Apply organic nutrients for sustainable crop production
- Implement organic pest and disease management using botanical pesticides and IPM approaches
- Analyze and compare organic crop and livestock management practices
- Evaluate organic food quality and certification for health and sustainability

TEXTBOOKS:

1. Sharma A, "Hand book of Organic Farming", Agrobios, 2016
2. Somasundram E D, Udhaya Nandhini and Meyappan M, "Principles of Organic farming (Theory and Practical)", CRC press, 1st Edition, 2021

REFERENCES:

1. Gupta S K, "Organic vegetable production", Rajat Publications, New Delhi, 2008
2. Singh S K, R B Yadav, Jagdish singh and Bijendra singh, "Organic Farming in Vegetables", ICAR Technical Publication, New Delhi, 2017

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	1	-	-	-	-	1
CO2	2	2	-	-	-	1	-	-	-	-	1
CO3	2	2	-	-	-	1	-	-	-	-	1
CO4	2	2	-	-	-	1	-	-	-	-	1
CO5	2	2	-	-	-	1	-	-	-	-	1

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BoS (AGE)

24AG202OE INTRODUCTION TO GREEN HOUSE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Know the importance, types and uses of greenhouses
- Use land survey and foundation methods in greenhouse design
- Practice installation of greenhouse structures and coverings
- Check and analyze maintenance needs of greenhouse structures
- Evaluate safety measures and emergency procedures in greenhouse operation

UNIT I GENERAL CONCEPTS OF GREEN HOUSE 9

Introduction to green house – Scope and Importance – Types of Green houses – Potential crop for green house.

UNIT II GREEN HOUSE DESIGN AND LAYOUT 9

Land survey and levelling – Assessment of structural strength, foundation specifications.

UNIT III INSTALLATION OF GREEN HOUSE 9

Erection of greenhouse structures – Covering with nets and shades – Types of glazing material and its characteristics – Checking of gutters.

UNIT IV MAINTENANCE OF GREEN HOUSE 9

Maintenance of erected structures – Maintenance of operational elements of the greenhouse for periodic checking, tightening, greasing etc.

UNIT V HEALTH AND SAFETY 9

Understanding about basic safety checks – Operation of all machinery and vehicles and hazards – Render appropriate emergency procedures.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the scope, importance, types of greenhouses and their suitable crops
- Apply foundation principles for greenhouse design and layout
- Demonstrate installation of greenhouse structures, including glazing, nets and shades
- Analyze maintenance needs of greenhouse structures and operations for efficiency
- Evaluate safety measures and emergency procedures in greenhouse management

V.Gopal

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28.10.25

TEXTBOOKS:

1. Prasad S and Kumar U, "Greenhouse Management of Horticultural Crops, Agrobios, 2nd Edition", 2010
2. Bose T K and Som G M, "Vegetable Crops in India", Naya Prokash, Kolkata, 1986

REFERENCES:

1. Roger Marshall, "The Greenhouse Gardener's Manual", Timber press, 2014

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	2	1	-	1	-	-	-	-	-	1
CO5	3	2	1	-	1	1	-	-	-	-	1

CHAIRMAN
BoS (AGE)

28.10.25

24CE201OE	GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be made to:

- Understand earth system and climate change impact.
- Infer basics of climate parameters and climate change causing elements
- Interpret atmosphere with its composition.
- Develop impact of climate change on various sectors.
- Make use of weather and climate parameters measuring instruments.

UNIT I CLIMATOLOGY 9

Introduction to earth system - Hydrosphere - lithosphere - cryosphere - atmosphere and biosphere - Climatology - Climate change impact in different sectors - Climate change mitigations and adaptations - Climate change negotiations - Earth system - hydrological cycle and carbon cycle - Paleoclimatology - Agriculture - Climate change Organization and programmes - Mitigation measures

UNIT II CLIMATOLOGY PROXIES 9

Earth system- cryosphere and biosphere - Climatology proxies - Forestry – IPCC - Intergovernmental Panel on Climate Change and assessment report highlights - Use of renewable resources- solar energy- Importance of earth system and climate - Indian climate system and their classification - Fishery - IPCC Assessment Report 1- Wind energy

UNIT III ATMOSPHERE AND ITS COMPOSITION 9

Atmosphere and its composition - Role of land and ocean to regulate climate- Socio economic impact – tourism - IPCC Assessment Report 2- different strata of atmosphere and temperature profile - Role of ice and wind to regulate climate - industries and business - IPCC Assessment Report

UNIT IV WEATHER AND CLIMATE 9

Weather and Climate - Causes of climate change - Milankovitch theory (change Natural cause) - Acid rain and human health impact - IPCC Assessment Report 4 - Climate parameter - temperature - atmospheric pressure - Milankovitch theory and climate - Sea surface temperature increases and aquatic organisms impact - IPC-Assessment Report 5 - Concept of sustainable development.

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UNIT V ATMOSPHERIC HUMIDITY AND RAINFALL 9

Atmospheric humidity and rainfall - Human induced climate change (anthropogenic causes) - Weather and climate parametèrs measuring instruments - UNEP - United Nations Environment Programme - Concept of Carbon sequestration - Wind circulation - Global radiance balance of climate system – thermometer - hygrometer or psychomotor WMO - World Meteorological Organization - Terrestrial sequestration.

TOTAL: 45 PERIODS

OUTCOMES:

On Successful completion of this course, the students will be able to:

- Explain the importance of earth system and climate change adaptations mitigations
- Summarize climate parameters and their impact due to human activities.
- Demonstrate the impact of climate change in various sectors.
- Organize different protocol related to climate change with its causes and impact.
- Analyze projects related to atmospheric humidity and rainfall.

TEXT BOOKS:

1. Dr. Zeena Flavia D Souza, Dr. Arpan Ray, Dr. Sayantan Dutta and Dr. Komala H.K., "Global Warming-Climate Change", Kiwi International Publishing House, Madurai, 2025.
2. Dr. Md. Shahnawaz, "Global Warming and Climate Change Problem Policies and Politics", Generic Publishing, 2017.

REFERENCES:

1. Wallace J.M and Hobbs P.V, "Atmospheric Science", Elsevier, Academic Press,2006.
2. Bates B.C, Kundzewicz Z.W, Wu S and Palutikof J.P, "Climate Change and Water Technical Paper of the Intergovernmental Panel on Climate Change", IPCC Secretariat, 2008.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	2	-	-	-	-	1
CO2	2	-	-	-	-	2	-	-	-	-	1
CO3	2	-	-	-	-	3	2	-	-	-	1
CO4	2	-	-	-	-	3	3	-	-	-	1
CO5	2	-	-	-	2	2	2	-	-	-	1

CHAIRMAN
BoS (CIVIL)

28.10.25

24CE202OE	BUILDING SERVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand comfortable and safe construction with the services designed and installed.
- Infer knowledge on basis of electrical wiring system and telecommunication.
- Summarize importance of principles of illumination in buildings.
- Develop awareness on various principles of refrigerant and heat recovery devices.
- Organize fire safety installation and electric alarm circuits.

UNIT I MACHINERIES 9

Introduction of lifts and Escalators – Special features required for lifting arrangement and installation – Travelators – Controls – Machine room and equipments.

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS 9

Basics of electricity distribution – Earthing systems and bonding – Electrical wiring – Industrial installations – Lighting controls – Light sources, Lamps, Lighting design – Telecommunication installations.

UNIT III PRINCIPLES OF ILLUMINATION 9

Ventilation requirements – Mechanical ventilation – Fans and types – Boilers and types – Water treatments – Solar heating of water – Hot water storage cylinders.

UNIT IV REFRIGERATION PRINCIPLES 9

Heat emitters – Expansion facilities of heating system – Energy management system – Factors affecting fuels – Oil sand properties of natural gas – Air conditioning, principles and applications – Refrigerant and system characteristics – Heat recovery devices.

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UNIT V FIRE SAFETY INSTALLATION 9

Fire prevention and control systems – Fire alarms – Electrical alarm circuits – Smoke extraction and ventilation – Gas extinguishers – Types of detectors – Gas installation and components.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to:

- Explain the special features in installation of lifts and escalators.
- Demonstrate electricity distribution earthing systems and bonding in buildings.
- Outline requirements of ventilation and principles of illumination.
- Utilize air conditioning and energy management system in buildings.
- Analyze need for fire detection and protection in working environment.

TEXT BOOKS:

1. Roger Greeno and Fred Hall, "Building Services Handbook", Elsevier Publishers 4th Edition, 2007.
2. Rao S and P Saluja H L,"Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1st Edition, 2016.

REFERENCES:

1. Steffy G, "Architectural Lighting Design", John Wiley and Sons, 3rd Edition, 2008.
2. Killinger J and Killinger L, "Heating and Cooling Essentials", Goodheart Wilcox Publishers, 2003.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	2	2	2	-	-	-	1
CO2	2	-	-	-	2	2	3	-	-	-	1
CO3	2	-	-	-	2	3	3	-	-	-	1
CO4	2	-	-	-	2	3	3	-	-	-	
CO5	2	-	-	-	2	2	2	-	-	-	

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24CS201OE	FUNDAMENTALS OF OPERATING SYSTEMS (Common to AGE, CIVIL, BME, ECE, EEE & MECH)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Illustrate the fundamental concepts and functions of operating systems.
- Discuss the management of processes and threads.
- Examine process synchronization, inter-process communication, and deadlock situations.
- Implement memory management strategies, including virtual memory.
- Assess file systems, disk scheduling, and I/O management techniques.

UNIT I INTRODUCTION **9**

Introduction to Operating Systems - Operating System Operations - Resource Management - Operating System Services – Virtualization - User and Operating System Interface - System Calls - Operating System Structures - Building and Booting an Operating System.

UNIT II PROCESSES AND THREADS **9**

Process Concept - Process Scheduling - Operations on Processes - Interprocess Communication - IPC in Shared - Memory Systems - IPC in Message - Passing Systems - Examples of IPC Systems - Threads - Overview - Multithreading models - Pthreads

UNIT III PROCESS MANAGEMENT AND SYNCHRONIZATION **9**

Basic Concepts of CPU Scheduling - Scheduling Criteria - Scheduling Algorithms - The Critical - Section Problem - Peterson's Solution - Synchronization Hardware - Mutex Locks - Semaphores - Classic Problems of Synchronization - Monitors - Deadlocks - Prevention - Avoidance – Detection - Recovery

UNIT IV MEMORY MANAGEMENT **9**

Contiguous Memory Allocation - Paging - Structure of the Page Table - Segmentation - Swapping - Example Architectures - Demand Paging - Page Replacement - Allocation of Frames - Thrashing

UNIT V STORAGE MANAGEMENT **9**

File Concept - Access Methods - Directory Structure - Protection - Directory Implementation - Allocation Methods – Free - Space Management – Mass - Storage Structure - HDD Scheduling

TOTAL: 45 PERIODS

CHAIRMAN
BoS (CSE)

Mech

OUTCOMES:

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

- Understand the structure, services, and basic functionalities of operating systems.
- Analyze process and thread creation, management, and inter-process communication.
- Design scheduling algorithms and apply synchronization and deadlock handling techniques.
- Evaluate and compare memory management schemes like paging and segmentation.
- Analyze file systems, disk scheduling, and I/O management in storage systems.

TEXT BOOKS:

1. Abraham Silberschatz, Greg Gagne and Peter B. Galvin. "Operating System Concepts", 10th Edition, John Wiley & Sons Inc., 2018.

REFERENCES:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. D. M. Dhamdhere. "'Operating Systems: A Concept– Based Approach"', 3rd Edition, Tata McGrawHill, 2017.
3. William Stallings. "Operating Systems: Internals and Design Principles", 9th Edition, Pearson, 2017.
4. Andrew S. Tanenbaum, Herbert Bos. "Modern Operating Systems", 5th Edition, Pearson, 2023.
5. Douglas Comer, "Operating System Design: The Xinu Approach", 2nd Edition, CRC Press, 2023.

COs - POs Mapping

COURSE OUTCOMES	PO										
	1	2	3	4	5	6	7	8	9	10	11
1	3	1	3	2	2	3	1	2	-	2	3
2	3	3	3	2	2	2	1	2	-	2	3
3	3	3	3	2	2	2	1	2	-	2	3
4	3	3	3	2	1	2	1	2	-	2	3
5	3	3	3	2	1	2	1	2	-	2	3

CHAIRMAN
BoS (CSE)

24CS202OE	INTRODUCTION TO DATABASE (Common to AGE, CIVIL, BME, ECE, EEE & MECH)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Describe the fundamentals of database systems and conceptual data modeling.
- Use the principles of the relational model to construct SQL queries.
- Develop database applications and design relational schemas.
- Examine transaction processing, concurrency control, and recovery mechanisms.
- Assess the role of Distributed Databases and NoSQL systems in modern applications.

UNIT I INTRODUCTION TO DATABASE SYSTEMS **9**

Introduction to Databases - File System Vs Database System - Data Models - Schemas and Instances - DBMS Architecture - Centralized - Client Server - Database Applications - ER Models - ER to Relational Mapping

UNIT II RELATIONAL MODELS **9**

Relational Model - Constraints - Keys - Dependencies - Relational Algebra - Unary, Binary, Set and Extended Relational Algebra operations - SQL - Data Definition - Data Manipulation and Retrieval Queries - Nested Queries - Joins - Views - Cursors - Procedures - Functions - Triggers - Embedded and Dynamic SQL

UNIT III RELATIONAL DATABASE DESIGN **9**

Database Design - Functional Dependencies - Normalization - 1 NF - 2 NF - 3 NF - BCNF - Multivalued Dependency (4 NF) - Join Dependency (PJNF)

UNIT IV TRANSACTIONS AND RECOVERY **9**

Transaction processing concepts - Need for concurrency control and recovery - ACID Properties - Recoverability - Serializability - Concurrency Control - Two phase locking Techniques - Timestamp based protocol - Graph based protocol - Deadlock handling - Log based recovery - Two Phase Commit Protocol

UNIT V QUERY PROCESSING AND ADVANCED DATABASES **9**

Indexing and Hashing Techniques - Query Processing and Optimization - Sorting and Joins - Database Tuning - Introduction to Spatial and Temporal Databases - OO Databases - NoSQL.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (CSE)

OUTCOMES:

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

- Describe the basic database concepts and construct ER models for simple applications.
- Formulate SQL queries to manage and retrieve data from relational databases.
- Apply programming and design techniques to enhance database structure through normalization.
- Implement transactions using concurrency control and recovery methods.
- Analyze and evaluate Distributed and NoSQL databases for varied application needs.

TEXT BOOKS:

1. Jagdish Chandra Patni, Hitesh Kumar Sharma, Ravi Tomar, Avita Katal, "Database Management System An Evolutionary Approach", 2022.

REFERENCES:

1. Narain Gehani and Melliyal Annamalai, "The Database Book: Principles and Practice Using the Oracle Database System", Universities Press, 2012.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill, 2014.
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson/Addison, Wesley, 2016.
4. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.
5. Andreas Meier, Michael Kaufmann, "SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management", First Edition 2019.

COs - POs Mapping

COURSE OUTCOMES	PO										
	1	2	3	4	5	6	7	8	9	10	11
1	3	3	3	3	3	2	-	2	-	1	3
2	3	3	3	3	3	2	-	2	-	1	2
3	3	3	3	3	2	2	-	3	-	1	3
4	3	3	3	3	3	2	-	1	-	1	2
5	3	3	3	2	3	2	-	2	-	1	3

CHAIRMAN
BoS (CSE)

24EC201OE	BASICS OF VIRTUAL INSTRUMENTATION	L T P C 3 0 0 3

OBJECTIVES:

The Students Should be made to

- Introduce the concept and evolution of virtual instrumentation and its advantages over conventional systems.
- Familiarize students with the architecture, programming techniques, and data-flow concepts used in graphical programming environments.
- Enable students to understand various interfacing standards and data acquisition techniques for instrumentation systems.
- Develop skills to design and implement virtual instruments for real-time and embedded applications.
- Expose students to the available toolsets for signal processing, image processing, motion control, and control design.

UNIT I INTRODUCTION **9**

Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II PROGRAMMING TECHNIQUES **9**

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, mathscript.

UNIT III INTERFACE REQUIREMENTS **9**

Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI, VISA and IVI, Data Acquisition Hardware.

UNIT IV APPLICATION OF VIRTUAL INSTRUMENTATION **9**

Application of Virtual Instrumentation: Instrument Control using RS-232C and IEEE488, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, Active X programming, Publishing measurement data in the web.

UNIT V TOOLSETS **9**

Distributed I/O modules, Control Design and Simulation, Digital Signal processing tool kit, Image acquisition and processing, Motion control.

TOTAL:45 PERIODS

CHAIRMAN
BoS (ECE) 24/10/25

OUTCOMES:

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

- Explain the architecture and fundamental concepts of virtual instrumentation systems..
- Develop and debug virtual instruments using graphical programming techniques.
- Interface virtual instruments with hardware using standard communication and bus interfaces.
- Design real-time and embedded virtual instruments for industrial and research applications.
- Utilize advanced toolsets for control design, DSP, image processing, and motion control applications.

TEXT BOOK:

1. Gary Johnson. "LabVIEW Graphical Programming" 2nd edition, McGraw Hill, New York, 1997.
2. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey, 1997.

REFERENCES:

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
2. Rick Bitter, "LabVIEW Advanced Programming Technique", 2nd Edition, CRC Press, 2005
3. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Edition, PHI, 2001.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	-	-	-	-	-	1	2
CO2	2	3	3	2	2	-	-	-	-	2	3
CO3	2	2	3	2	3	-	-	-	-	2	3
CO4	2	3	3	2	3	-	1	-	-	2	3
CO5	2	2	3	2	3	-	1	-	-	2	3

CHAIRMAN
BoS (ECE)

24EC202OE	TELECOMMUNICATIONS FOR SOCIETY	L T P C 3 0 0 3

OBJECTIVES:

The Students Should be made to

- Introduce the basic structure and functioning of telecommunication systems and networks.
- Provide an understanding of various types of connectivity, numbering, routing, and switching used in telecommunications.
- Explain the concept of Quality of Service (QoS) for voice, data, and image transmission and the factors affecting it.
- Describe the transmission aspects of voice telephony and video communication systems.
- Familiarize students with television and CATV systems, their evolution, transmission standards, and digital implementation.

UNIT I INTRODUCTORY TO TELECOMMUNICATIONS **9**

End-Users, Nodes, and Connectivities, Telephone Numbering and Routing, Use of Tandem Switches in a Local Area Connectivity, Introduction to the Busy Hour and Grade of Service, Simplex, Half-Duplex, and Full Duplex, One-Way and Two-Way Circuits, Network Topologies, Variations in Traffic Flow, Quality Of Service, Standardization in Telecommunications, The Organization of the PSTN in the United States, Points of Presence.

UNIT II QUALITY OF SERVICE **9**

Objective, Quality of Service: Voice, Data, and Image, Signal-to-Noise Ratio, Voice Transmission, Data Circuits, Video (Television), The Three Basic Impairments and How They Affect the End-User, Amplitude Distortion, Phase Distortion, Noise Level, Typical Levels, Echo and Singing.

UNIT III TRANSMISSION ASPECTS OF VOICE TELEPHONY **9**

Definition of the Voice Channel, Operation of the Telephone Subset, Subscriber Loop Design, Design of Local Area Wire-Pair Trunks (Junctions), VF Repeaters (Amplifiers).

UNIT IV TELEVISION TRANSMISSION **9**

Background and Objectives, An Appreciation of Video Transmission, Critical Video Parameters, Video Transmission Standards (Criteria for Broadcasters), Methods of Program Channel Transmission, The Transmission of Video Over LOS Microwave, TV Transmission by Satellite Relay, Digital Television, Conference Television, Brief Overview of Frame Transport for Video Conferencing.

UNIT V COMMUNITY ANTENNA TELEVISION **9**

Objective and Scope, The Evolution of CATV, System Impairments and Performance Measures, Hybrid Fiber-Coax (HFC) Systems, Digital Transmission of CATV Signals, Two-Way CATV Systems, Two-Way Voice and Data over CATV Systems Based on the DOCSIS 2.0 Specification, Subsplit / Extended Subsplit Frequency Plan, Other General Information.

TOTAL:45 PERIODS

CHAIRMAN
BoS (ECE) 28/10/25

OUTCOMES:

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

- Explain the fundamental components and connectivity structures in telecommunication networks.
- Analyze the impact of Quality-of-Service parameters on voice, data, and image transmission.
- Illustrate the transmission aspects of voice telephony including subscriber loops, trunks, and repeaters.
- Describe the principles and standards used in television and video transmission systems.
- Evaluate the design and performance of CATV and digital cable transmission systems.

TEXT BOOK:

1. Roger L. Freeman, "Fundamentals of Telecommunications" 2nd Edition, John Wiley & Sons Publications 2005.
2. Annabel Z. Dodd, "The Essential Guide to Telecommunications", 5th Edition, Prentice Hall 2012.

REFERENCES:

1. Jyrki T. J. Penttinen, "The Telecommunications Handbook" John Wiley & Sons Publications 2015.
2. Prof. Dr. Muhammad EL-SABA, "Telecommunications systems and data networks", 3rd Edition 2015.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	-	-	-	-	1	-
CO2	2	3	2	3	3	-	1	-	-	2	1
CO3	3	3	3	2	3	-	-	-	-	2	1
CO4	2	2	3	2	3	-	-	-	-	2	2
CO5	2	3	3	3	3	-	1	-	-	2	2

CHAIRMAN
BoS (ECE)

24EE201OE	ENERGY AUDIT AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made to:

- Understand the knowledge of energy basics, energy accounting and audit processes
- Learn strategies for energy management in electric motors and cogeneration systems
- Familiarize with lighting systems and their optimization for energy efficiency
- Describe the principles and techniques of metering for effective energy management in various electrical systems
- Apply economic analysis and modeling to justify energy management decisions

UNIT I INTRODUCTION 9

Basics of Energy – Need for energy management – Energy accounting – Energy monitoring, targeting and reporting – Energy audit process.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9

Energy management for electric motors – Transformer and reactors – Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

UNIT III LIGHTING SYSTEMS 9

Energy management in lighting systems – Task and the working space – Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Metering for energy management – Units of measure – Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location versus requirements, metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS 9

Economic analysis – Economic models – Time value of money – Utility rate structures – Cost of electricity – Loss evaluation and load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45 PERIODS

CHAIRMAN
BoS(EEE) 28/10/25

COURSE OUTCOMES:

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

- Explain the need for energy management, energy accounting and auditing techniques
- Apply energy management practices to motors, transformers and cogeneration systems
- Analyze lighting systems with respect to energy consumption, power factor and harmonics
- Interpret metering instruments, transformer burdens and metering techniques for energy management
- Develop and justify economic models for energy projects including demand-side management and HVAC systems

TEXT BOOK:

1. Barney L Capehart, Wayne C Turner and William J Kennedy, "Guide to Energy Management", Eighth Edition, River Publishers, 2016.

REFERENCES:

1. Stephen A Roosa, Steve Doty, Wayne Turner, "Energy Management Handbook", Ninth Edition, River Publishers, 2018.
2. Witte L C, "Industrial energy management and utilization", Washington: Hemisphere Publication Corporation. 2023.
3. Dale R Patrick, Stephen W Fardo, Ray E Richardson, Steven R Patrick, "Energy Conservation guide book", Second Edition, CRC Press, 2007.
4. Albert Thumann and William J Younger, "Handbook of Energy Audits", Ninth Edition, Fairmont Press, 2012.
5. Web/Digital resources: https://beeindia.gov.in/content/energy-auditors.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	–	–	–	–	–	–	–	1
CO2	3	3	2	–	–	–	–	–	–	–	1
CO3	3	3	2	–	–	–	–	–	–	–	2
CO4	3	2	2	–	–	–	–	–	–	–	2
CO5	3	3	3	–	–	–	–	–	–	–	2

CHAIRMAN
BoS(EEE)

24EE202OE	ELECTRIC VEHICLES	L T P C
		3 0 0 3

COURSE OBJECTIVES:

The students should be made to:

- Identify the basic components, historical development and environmental impact of electric and hybrid vehicles
- Summarize the principles of vehicle motion, propulsion requirements and the mechanics of tire-road interaction
- Discuss the characteristics of various electric and hybrid vehicle architectures and transmission systems
- Interpret the configuration and control methods of electric motor drives used in hybrid and electric vehicles
- Explain different energy storage technologies and the process of selecting and sizing propulsion motors

UNIT I INTRODUCTION 9

Electric and Hybrid Electric Vehicles – Components – History of hybrid and electric vehicles – Social and environmental importance of hybrid and electric vehicles – Impact of modern drive–trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance – Vehicle power source characterization – Transmission characteristics – Mathematical models to describe vehicle performance.

UNIT II VEHICLE MECHANICS 9

Roadway fundamentals – Vehicle kinetics – Dynamics of vehicle motion – Propulsion power – Velocity and acceleration: Constant F_{TR} level road, Non-constant F_{TR} general acceleration – Tire-road force mechanics – Propulsion system design.

UNIT III VEHICLE ARCHITECTURE 9

Electric Vehicle Architecture – Hybrid Electric Vehicle Architecture: Hybrids based on Architecture, Hybrids based on transmission assembly – Hybrids based on degree of hybridization – Plug in hybrid electric vehicle. Mountain bike – Motor cycle.

UNIT IV ELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles – Configuration and control – DC motor drives, Induction motor drives, Permanent magnet drives and Switched reluctance drives.

UNIT V ENERGY STORAGE AND SIZING 9

Introduction to energy storage requirements in Hybrid and Electric vehicles, Energy storage and analysis – Battery, Fuel, Super Capacitor, Hybridization of different energy storage devices, Power electronic converter for battery charging. Sizing of propulsion motor.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (EEE) 28/10/25

COURSE OUTCOMES:

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

- Describe the components, history and environmental significance of electric and hybrid vehicles
- Explain the fundamentals of vehicle motion, propulsion power and tire-road force mechanics
- Examine different electric and hybrid vehicle architectures and their transmission assemblies
- Summarize the configuration of various electric motor drives used in hybrid and electric vehicles
- Analyse various energy storage techniques and the sizing of propulsion motors for hybrid and electric vehicles

TEXT BOOKS:

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", Second Edition, CRC Press, 2003.
2. Ali Emadi, "Advanced Electric Drive Vehicles", First Edition, CRC Press, 2017.

REFERENCES:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
2. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley and Sons, 2003.
3. Seth Leitman and Bob Brant, "Build Your Own Electric Vehicle", Third Edition, McGraw Hill, 2013.
4. Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe and Kari Tammi, "Heavy-duty Electric Vehicles from Concept to Reality", Elsevier Science, 2021.
5. Rabiul Islam Md, Rakibuzzaman Shah Md and Hasan Ali Mohd, "Emerging Power Converters for Renewable Energy and Electric Vehicles: Modeling, Design and Control", First Edition, CRC Press, 2021.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	–	–	–	–	–	–	–	1
CO2	3	2	2	–	–	–	–	–	–	–	1
CO3	3	3	2	–	–	–	–	–	–	–	2
CO4	3	3	2	–	–	–	–	–	–	–	2
CO5	3	3	3	–	–	–	–	–	–	–	2

CHAIRMAN
BoS (EEE)

24ME201OE	BASICS OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Provide knowledge on various engine components of automobiles.
- Explain the working principles of flywheel, Clutch, and Transmission systems
- Understanding the vehicle construction, body layouts and aerodynamics.
- Familiarize with steering, suspension, and braking systems, including modern technologies like ABS and power steering
- Know the concepts of hybrid vehicle technologies, their components, working, and comparative advantages over conventional vehicles

UNIT I ENGINE COMPONENTS 9

Overview – Engine Components – Engine block, Crank shaft, Connecting rod, Cylinder Liners, Piston, Piston rings, Cylinder head – Camshaft, Valve, Rocker Arm, Spark Plug, Injector, Carburetor, Fuel pump.

UNIT II TRANSMISSION COMPONENTS 9

Flywheel – Clutch – Friction plate, Clutch housing, Pressure plate. Gearbox – Propeller shaft – Differential – Conventional Differential, Rear axle.

UNIT III BODY COMPONENTS 9

Types of automobiles – Vehicle construction and different layouts, chassis, Frame and body – Vehicle aerodynamics.

UNIT IV STEERING, SUSPENSION SYSTEMS AND BRAKES 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS).

UNIT V IGNITION SYSTEMS AND HYBRID VEHICLE 9

Ignition System – Battery and Magneto Ignition System – Principles of Combustion and detonation CI Engines. Lubrication and Cooling systems. Hybrid Vehicles: Components of hybrid vehicles - layout & working principle of hybrid vehicles - comparison with electric vehicles - advantages and disadvantages of hybrid vehicles.

TOTAL: 45 PERIODS

CHAIRMAN
(BoS / MECH) 28/10/25

OUTCOMES:

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

- Describe the construction, function, and operation of major engine components.
- Explain the working and application of transmission components such as clutch, gearbox, propeller shaft, and differential.
- Compare different automobile layouts, chassis designs, and evaluate their impact on vehicle aerodynamics
- Summarize the design and performance of steering systems, suspension arrangements, and braking mechanisms, including modern safety systems
- Develop the suitability of ignition systems, and explain the principles of hybrid vehicle.

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Vol. 1 and 2, Seventh Edition, Standard Publishers, New Delhi, 14th Edition 2017.
2. Ganesan V, "Internal Combustion Engines", Tata McGraw-Hill, 4th Edition, 2018.

REFERENCES:

1. Joseph Heitner, "Automotive Mechanics," East-West Press, Second Edition, 1999.
2. Jain K K and Asthana R B, "Automobile Engineering", Tata McGraw Hill Publishers, New Delhi, 2002.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals", The Good Heart-Will Cox Company Inc, USA, 1978.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

CHAIRMAN
(BoS / MECH)

24ME202OE	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the principles and applications of mechanical energy-based unconventional machining processes.
- Explain the working mechanisms of thermal and electrical energy-based machining processes.
- Familiarize with machining of chemical and electrochemical-based processes.
- Examine the capabilities and limitations of advanced nano-finishing processes.
- Outline the scope and trends of advanced non-traditional machining processes.

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification - merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles–equipment used – Process parameters–MRR – Applications.

UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wirecut EDM - Working Principle – equipments – Process Parameters – Surface Finish and MRR - electrode /Tool - Power and control Circuits – Tool Wear – Dielectric – Flushing - Applications. Laser Beam machining and drilling (LBM) – plasma, Arc machining (PAM) and Electron Beam Machining (EBM) – Principles – Equipment - Types – Beam control techniques – Applications.

UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro – Chemical machining (CHM and ECM) – Etchants – Maskant – techniques of applying maskants – Process Parameters – Surface finish and MRR – Applications. Principles of ECM – equipment's –Surface Roughness and MRR Electrical circuit–Process Parameters – ECG and ECH– Applications.

UNIT IV ADVANCED NANOFINISHING PROCESSES 9

Abrasive flow machining – chemo -mechanical polishing – magnetic abrasive finishing, magneto Rheological finishing – magneto rheological abrasive flow finishing - their working principles, equipments - effect of process parameters – applications - advantages and limitations.

CHAIRMAN
(BoS / MECH) 28/10/25

UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes - their working principles - equipments, effect of process parameters – applications - advantages and limitations – Comparison of non-traditional machining processes.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Recognize the need for unconventional machining processes and their classification.
- Contrast various thermal energy and electrical energy based unconventional machining processes.
- Explain various chemical and electrochemical energy-based unconventional machining processes.
- Discuss various nano-abrasive-based unconventional machining processes.
- Differentiate various recent trends in unconventional machining processes.

TEXT BOOKS:

1. Vijay K Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P C and Shan H S, "Modern Machining Processes", Tata McGraw Hill, New Delhi, 2011.

REFERENCES:

1. Benedict GF, "Non traditional Manufacturing Processes", Taylor and Francis Limited, 2019
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1988.
3. Ernest Paul De Garmo, Black J T and Ronald A Kohser, "Material and Processesing Manufacturing", John Wiley and Sons, Inc., 13th Edition, 2020.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

CHAIRMAN
(BoS / MECH)

28/10/25

24IT201OE	INTRODUCTION TO WEB DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Learn the fundamentals of Internet, World Wide Web, protocols, browsers, and web servers.
- Understand design structured, interactive, and user-centric web pages using HTML, CSS, and JavaScript.
- Explore skills to manipulate the DOM and implement client-side scripting for dynamic web content.
- Familiarize with XML, PHP, and integration of PHP with databases using MySQL.
- Acquire knowledge to plan, implement, and publish complete web applications.

UNIT I WEB BASICS AND DESIGN **9**

Introduction: Concept of WWW - Internet Vs. WWW - HTTP Protocol - Request and Response - Web Browsers and Web Servers - Features of Latest Version of Web. Web Design: Concepts of Effective Web Design - Browser Compatibility - Bandwidth - Cache - Display Resolution: Look and Feel of the Website - Page Layout - and Linking - User-centric Design: Sitemap - Planning and Publishing a Website.

UNIT II HTML AND CSS **9**

HTML: Basics of HTML - Text Formatting - Fonts - Commenting Code - Colors - Hyperlinks - Lists - Tables - Images - Forms - XHTML - Meta Tags - Character Entities - Frames and Frame sets - Browser Architecture and Website Structure - Overview of Latest HTML version Features. CSS: Need - Introduction - Syntax and Structure - Backgrounds - Colors - Text Styling - Fonts - Borders - Boxes - Margins -Padding - Lists.

UNIT III JAVASCRIPT AND DHTML **9**

JavaScript: Client-side scripting - Variables - Functions - Conditional Statements - Loops and Repetition - Pop-up boxes and alerts - Advanced JavaScript: Objects - JavaScript's Built-in Objects - DOM - Web Bowser Environments - DOM manipulation - Forms - Validations.

UNIT IV XML AND PHP BASICS **9**

XML: Introduction - Uses - Simple XML - Key Components - DTD and Schema - XML with applications - Transforming XML using XSL and XSLT.

CHAIRMAN
BoS (IT)

PHP: Introduction and basic syntax - Decision-making and looping - PHP and HTML integration - Arrays and Functions - Browser control and detection - Strings, - Form Processing - File Handling - Advanced features: Cookies and Sessions.

UNIT V PHP AND MYSQL **9**

PHP - MySQL integration: Basic commands - Connection to server - Creating Databases and Tables - Selecting Databases - Listing Databases and Table Names - Insertion - Update - Delete data and Tables - Handling Database Errors - Database Management - Case Study.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Able to explain web fundamentals, protocols, browsers, and server concepts.
- Design structured, interactive, and user-centric web pages using HTML and CSS.
- Implement dynamic client-side functionality using JavaScript and DHTML.
- Develop server-side scripts using PHP and integrate them with XML and MySQL databases.
- Implement and publish functional web applications using PHP-MySQL.

TEXT BOOKs:

1. HTML 5 Black Book - Web Technologies: HTML, XHTML, CSS, XML, JavaScript, AJAX, PHP and MySQL, 2nd Edition, Dreamtech Press, 2016.

REFERENCES:

1. Ivan Bayross, Web Enabled Commercial Application Development Using HTML, DHTML, JavaScript, Perl, CGI, PHP, and MySQL, BPB Publications, 2020.
2. Achyut S. Godbole & Atul Kahate, Web Technologies: TCP/IP to Internet Application Architectures, McGraw Hill, 2018.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	1	-	1	-	-	-	-	-	2
2	2	2	3	-	2	1	-	1	2	-	2
3	2	2	3	-	3	-	-	1	2	-	2
4	3	3	3	2	3	1	-	1	2	1	3
5	3	3	3	2	3	1	1	2	3	2	3

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BoS (IT)

28/10/25

24IT202OE	PRINCIPLES OF MULTIMEDIA	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Provide an understanding of multimedia systems, applications, and underlying principles.
- Introduce various multimedia data types such as text, audio, image, video, and animation.
- Explain data compression techniques for efficient storage and transmission.
- Familiarize students with multimedia authoring tools, software, and design principles.
- Explore applications of multimedia in communication, education, entertainment, and the web.

UNIT I INTRODUCTION TO MULTIMEDIA **9**

Multimedia: Introduction - Definitions - Components - Text - Audio - Video - Graphics and Animation - Multimedia Applications: Education, Entertainment - Training - Kiosks and Presentations - Multimedia System Architecture - Multimedia Hardware: Input/ Output Devices - Storage Devices - Multimedia Software: Authoring Tools - Presentation Tools - Virtual Reality and Multimedia.

UNIT II TEXT, AUDIO AND IMAGE **9**

Text: Types of Text - Unicode Standards - Text Compression Techniques - Audio: Acoustics - Digital Representation of Sound - Waveform and MIDI Audio - Audio Compression Techniques - Audio Standards - Image: Digital Image Representation - Color Models - Sampling and Quantization - Image Formats - Image Compression Standards.

UNIT III VIDEO AND ANIMATION **9**

Video: Analog and Digital Video - Video Formats - Characteristics of Video Signals – Digitization - Video Compression Standards - Animation: Types of Animation - Principles of Animation - Animation Techniques - Morphing - Motion Capture - Animation Software Tools.

UNIT IV MULTIMEDIA DATA COMPRESSION **9**

Need for compression - Lossless Compression Techniques: Run Length Encoding - Huffman Coding - Arithmetic Coding - Dictionary Based Compression - Lossy Compression Techniques: Transform coding - JPEG, MPEG Compression - Comparison of Compression Techniques and their Applications in Multimedia Systems.

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UNIT V MULTIMEDIA TOOLS AND APPLICATIONS 9

Multimedia Authoring Tools: Authoring Metaphors - Card-Based - Timeline-Based - Icon-Based and Object-Oriented Authoring - Multimedia Databases - Multimedia Applications in Education - Business - Entertainment and the Web - Designing Multimedia Applications - Multimedia and the Internet - Future Trends in Multimedia Technology.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the fundamentals, architecture, and applications of multimedia systems.
- Understand representation, storage, and processing of text, audio, and images.
- Explain video and animation concepts with related standards and techniques.
- Apply compression algorithms for efficient multimedia storage and transmission.
- Use authoring tools to design simple multimedia applications for real-world domains.

TEXT BOOKs:

1. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Springer, 2nd Edition, 2021.

REFERENCES:

1. Ralf Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communications and Applications, Pearson Education, 2019.
2. Tay Vaughan, Multimedia: Making It Work, 9th Edition, McGraw Hill, 2018.
3. Prabhat K. Andleigh and Kiran Thakrar, Multimedia Systems Design, PHI, 2020.
4. Fred T. Hofstetter, Multimedia: Basics, Technology, and Future, Pearson, 2019.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	1	-	1	1	-	-	-	-	2
2	3	2	2	1	2	-	-	-	-	-	2
3	2	2	3	-	2	1	-	-	-	-	2
4	3	3	2	2	3	-	-	-	-	-	2
5	2	2	3	1	3	1	1	2	2	2	3

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28/10/25

24M101	FINANCIAL MANAGEMENT	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Student should be made to:

- Understand the knowledge of the decision areas in finance.
- Learn the various sources of Finance.
- Study about capital budgeting and cost of capital.
- Learn on how to construct a robust capital structure and dividend policy.
- Study about the 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.

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: 45 PERIODS

CHAIRMAN
BoS (IT)

OUTCOMES:

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

- Explain about the decision areas in finance.
- Discuss about the various sources of Finance.
- Work on capital budgeting and cost of capital.
- Construct a robust capital structure and dividend policy.
- Handle the tools on Working Capital Management.

TEXT BOOKs:

1. M.Y. Khan and P.K.Jain, Financial management, Text, Tata McGraw Hill, Ltd.
2. M. Pandey, Financial Management, Vikas Publishing House Pvt. Ltd.

REFERENCES:

1. James C. Vanhorne, Fundamentals of Financial Management, PHI Learning.
2. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	2	1	-	-	-	1	-	-	3	3	2
2	2	1	-	-	-	1	2	-	3	3	2
3	2	1	-	-	-	1	-	--	3	3	2
4	2	1	-	-	-	1	2	-	3	3	2
5	2	1	-	-	-	1	-	-	3	3	2

CHAIRMAN
BoS (IT)

28/10/24

24M102	FUNDAMENTALS OF INVESTMENT	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Student should be made to:

- Study about the investment environment in which investment decisions are taken.
- Acquire knowledge on how to Value bonds and equities.
- Learn the various approaches to value securities.
- Study on how to create efficient portfolios through diversification.
- Learn the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT **9**

Investment Decision Process - Types of Investments - Commodities - Real Estate and Financial Assets - Indian Securities Market - Market Participants and Trading of Securities - Security Market Indices - Sources of Financial Information - Concept of Return and Risk - Impact of Taxes and Inflation on Return.

UNIT II FIXED INCOME SECURITIES **9**

Bond Features - Types of Bonds - Estimating Bond Yields - Bond Valuation Types of Bond Risks - Default Risk and Credit Rating.

UNIT III APPROACHES TO EQUITY ANALYSIS **9**

Introduction to Fundamental Analysis - Technical Analysis and Efficient Market Hypothesis - Dividend Capitalization Models - 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**

Investor Grievances and their Redressal System - Insider Trading - Investors' Awareness and Activism.

TOTAL: 45 PERIODS

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BoS (IT)

OUTCOMES:

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

- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities.
- Explain the various approaches to value securities.
- Create efficient portfolios through diversification.
- Discuss the mechanism of investor protection in India.

TEXT BOOKs:

1. Charles P. Jones - Gerald R. Jensen, Investments: analysis and management. Wiley - 14th Edition - 2019.

REFERENCES:

1. Chandra, Prasanna, Investment analysis and portfolio management. McGraw-hill education, 5th Edition, 2017.
2. Rustagi R. P, Investment Management Theory and Practice. Sultan Chand & Sons - 2021.
3. ZviBodie, Alex Kane, Alan J Marcus , PitabusMohanty, Investments - McGraw Hill Education (India), 11th Edition, 2019.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	-	-	2	-	-	-	-	-	1
2	3	3	-	2	2	-	-	-	-	-	-
3	3	3	2	-	2	-	-	-	-	-	-
4	3	-	-	2	2	-	-	-	-	-	1
5	-	-	-	-	-	2	-	3	-	-	1

CHAIRMAN
BoS (IT)

28/ 05/ 25

24M103	BANKING, FINANCIAL SERVICES AND INSURANCE	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Student should be made to:

- Study about the Banking system in India.
- Understand knowledge on how banks raise their sources and how they deploy it.
- Learn the development in banking technology.
- Study about the financial services in India.
- Acquire knowledge about 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 and 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 - 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 - 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: 45 PERIODS

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BoS (IT)

OUTCOMES:

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

- Understand the Banking system in India.
- Discuss how banks raise their sources and how they deploy it.
- Explain the development in banking technology.
- Discuss about the financial services in India.
- Explain the insurance Industry in India.

TEXT BOOKs:

- Padmalatha Suresh and Justin Paul, Management of Banking and Financial Services, Pearson, Delhi, 2017.

REFERENCES:

1. Meera Sharma, Management of Financial Institutions - with emphasis on Bank and Risk Management, PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Peter S. Rose and Sylvia C. and Hudgins, Bank Management and Financial Services, Tata McGraw Hill, New Delhi, 2017.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	3	1	-	-	2	-	-	-	1	-
2	2	3	-	-	-	-	-	-	-	3	-
3	3	3	2	-	-	-	-	-	-	-	-
4	2	3	2	3	-	-	-	-	-	-	3
5	3	2	-	-	3	2	-	-	-	-	-

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BoS (IT)

28/10/24

24M104	INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Student should be made to:

- Study about the introduction of blockchain technology.
- Acquire knowledge on the usage of Cryptocurrency.
- Learn about the concept of Ethereum technology.
- Study about the Web3 and Hyperledger concepts .
- Acquire knowledge about the emerging trends related to blockchain technology.

UNIT I INTRODUCTION TO BLOCKCHAIN **9**

Blockchain: Growth of Blockchain Technology - Distributed Systems - History of Blockchain and Bitcoin - Features of a Blockchain - Types - Consensus: Consensus Mechanism - Types - 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 - Ethereum Network - Components of the Ethereum Ecosystem - Transactions and Messages - Ether Cryptocurrency / Tokens - Ethereum Virtual Machine - Ethereum Development Environment: Test Networks - Setting up a Private Net - Starting up the Private Network.

UNIT IV WEB3 AND HYPERLEDGER **9**

Introduction to Web3 - Contract Deployment - POST Requests - Development Frameworks - Hyperledger as a Protocol - Reference Architecture - Hyperledger Fabric - Distributed Ledger - Corda.

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UNIT V EMERGING TRENDS **9**

Kadena - Ripple - Rootstock - Quorum - Tendermint - Scalability - Privacy - Other Challenges - Blockchain Research - Notable Projects - Miscellaneous Tools.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain about the introduction of blockchain technology.
- Discuss about the usage of Cryptocurrency.
- Elaborate about the concept of Ethereum technology.
- Discuss about the Web3 and Hyperledger concepts.
- Discuss about the emerging trends related to blockchain technology.

TEXT BOOKs:

1. Imran. Bashi, Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, Packet Publishing, 2nd Edition, 2018.

REFERENCES:

1. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
2. ArshdeepBahga, Vijay Madisetti, Blockchain Applications: A Hands On Approach, VPT, 2017.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	2	1	1	2	1	1	1	1	–	2
2	3	3	2	2	2	2	1	1	2	1	2
3	3	3	3	3	3	1	1	2	2	2	3
4	2	2	3	3	3	2	2	2	3	3	3
5	2	3	3	3	3	3	2	3	3	3	3

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24M105	FINTECH PERSONAL FINANCE AND PAYMENTS	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Student should be made to:

- Study about the currency exchange and payment
- Acquire knowledge on the concept of digital finance and alternative finance.
- Learn about the concept of insurtech.
- Study about the process of peer to peer lending
- Acquire knowledge about the various regulatory issues related to finance.

UNIT I CURRENCY EXCHANGE AND PAYMENT **9**

Understand the Concept of Crypto Currency - Bitcoin and Applications - Cryptocurrencies and Digital Crypto Wallets - Types of Cryptocurrencies - Applications - Block Chain - Artificial Intelligence - Machine Learning - Fintech Users - Individual Payments - RTGS Systems - Immediate Page 54 of 90 Payment Service (IMPS) - Unified Payments Interface - Legal and Regulatory Implications of Cryptocrrencies - 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 - Technology Issues.

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE **9**

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 InsurTech - IoT and InsurTech - Risk Modeling - Fraud Detection Processing Claims - Underwriting Innovations in Insurance Services.

UNIT IV PEER TO PEER LENDING **9**

P2P - Marketplace Lending - New Models - New Products in Market Place Lending P2P Infrastructure - Technologies - Concept of Crowdfunding - Architecture and Technology - Crowdfunding Unicorns and Business Models - SME/MSME Lending: Unique Opportunities and Challenges - Solutions and Innovations.

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UNIT V REGULATORY ISSUES **9**

FinTech Regulations: Global Regulations - Domestic Regulations - Evolution of RegTech - RegTech Ecosystem: Financial Institutions - RegTech Ecosystem: Startups RegTech - Startups: Challenges - RegTech Ecosystem: Regulators - Use of AI in Regulation - Fraud Detection.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain about the currency exchange and payment.
- Discuss on the concept of digital finance and alternative finance.
- Elaborate about the concept of insurtech.
- Discuss about the process of peer to peer lending.
- Explain about the various regulatory issues related to finance.

TEXT BOOKs:

- Swanson Seth, Fintech for Beginners: Understanding and utilizing the power of technology, Createspace Independent Publishing Platform, 2016.

REFERENCES:

- Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019.
- Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016.
- Jacob William, FinTech:TheBeginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016.
- IIBF, Digital Banking, Taxmann Publication, 2016.
- Jacob William, Financial Technology, Create space Independent Pub, 2016.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	3	2	2	3	2	1	2	1	2	1
2	3	3	3	2	2	2	2	2	1	2	1
3	3	3	3	3	3	2	2	2	2	2	1
4	3	3	3	3	3	3	2	2	2	2	1
5	3	3	2	3	2	3	3	3	2	2	2

CHAIRMAN
BoS (IT)

28/10/25

24M106	INTRODUCTION TO FINTECH (Common to all Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Learn about history, importance and evolution of Fintech.
- Acquire the knowledge of Fintech in payment industry.
- Acquire the knowledge of Fintech in insurance industry.
- Learn the Fintech developments around the world.
- Study about the future of Fintech.

UNIT I INTRODUCTION TO FINTECH **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.

UNIT II PAYMENT INDUSTRY **9**

Fintech in Payment Industry - Multichannel Digital Wallets - Applications Supporting Wallets - Onboarding and KYC Application - Fintech in Lending Industry - Formal Lending - Informal Lending - P2P Lending - POS Lending - Online Lending.

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 - Consultation - Customer Engagement through Quote to Sell - Policy Servicing - Claims Management - Investment Linked Health Insurance.

UNIT IV FINTECH AROUND THE GLOBE **9**

Fintech Developments - US - Europe - UK - Germany - Sweden - France - China - India - Regulatory and Policy Assessment for Growth of Fintech - Fintech as Disruptors - Financial Institutions Collaborating with Fintech Companies - New Financial World.

UNIT V FUTURE OF FINTECH **9**

How Emerging Technologies Will Change Financial Services - Future of Financial Services - Banking on Innovation through Data - Why Fintech Banks will Rule the World - Fintech Supermarket - Banks Partnering with Fintech Start-Ups - Rise of Banktech - Fintech Impact on Retail Banking - Future without Money - Ethics in Fintech.

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TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain about history, importance and evolution of Fintech.
- Discuss about the process of Fintech in payment industry.
- Discuss about the process of Fintech in insurance industry.
- Handle the process of the various Fintech around the world.
- Discuss about the future of Fintech.

TEXT BOOKs:

- Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015

REFERENCES:

- Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016.
- Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016.
- Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018.
- Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020.

COs – POs Mapping

COURSE OUTCOMES	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	3	3	2	2	2	2	1	2	1	2	1
2	3	3	3	3	3	2	2	2	1	2	1
3	3	3	3	3	3	3	2	2	2	2	1
4	3	3	3	3	3	3	3	3	2	3	2
5	3	3	2	3	3	3	3	3	2	3	2

CHAIRMAN
BoS (IT)

24M201	FOUNDATIONS OF ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the concepts, skills, traits, and factors influencing entrepreneurship.
- Integrate the concepts of business ownership, environmental factors, and functional areas of management for effective business decision-making.
- Study the concepts, principles, and characteristics of technopreneurship along with its societal, economic, and employment impacts.
- Explore technology-driven entrepreneurship, intrapreneurship, and global practices with focus on launching and managing tech-based ventures.
- Know effective business management strategies across diverse entrepreneurial forms and emerging trends at local, national, and global levels.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources. Mobilisation-Basics of Managing Finance- Essentials 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 - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities 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.

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UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP 9

Effective Business Management Strategies for Franchising - Sub-Contracting - Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Learn the different types of entrepreneurs and assess the contribution of entrepreneurship to economic development.
- Choose business environments, management principles in HR, finance, marketing, and production systems for efficient administration.
- Solve the emerging trends in technopreneurship and its role in creating innovations, job opportunities, and economic growth.
- Apply entrepreneurial practices in technology ventures, and assess success stories and case studies of technopreneurs.
- Analyze franchising, subcontracting, leasing, and new entrepreneurial models and assess their impact on recent entrepreneurial developments.

TEXT BOOKS:

1. Khanka S S, "Entrepreneurial Development", S.Chand & Co. Ltd., New Delhi, 2021.
2. Donal F Kuratko, "Entrepreneurship Theory, Process, Practice" Cengage Learning, 11th Edition, 2022.

REFERENCES:

1. Daniel Mankani, "Technopreneurship: The successful Entrepreneur in the new Economy", Prentice Hall, 2003.
2. Edward Elgar, "Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe", Wiley Publications, 2014.
3. Dennis Posadas, "JumpStart: A Technopreneurship Fable", Pearson Prentice Hall, 2009.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	-	-	-	-	2	-
CO2	2	2	1	-	-	1	1	1	1	2	-
CO3	2	2	1	-	-	1	1	1	1	2	-
CO4	2	2	1	-	1	1	1	1	1	2	1
CO5	2	2	1	-	1	2	1	1	1	2	1

CHAIRMAN
(BoS / MECH)

24M202	TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Describe the concepts of team dynamics, formation, and development.
- Integrate the leadership roles and strategies for building effective, high-performance teams.
- Interpret the attributes, traits, and power dimensions of effective leadership.
- Compare various leadership theories, models, and styles within organisational contexts.
- Know the behavioural aspects of leadership and challenges like conflict, negotiations

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 Behaviours - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Differentiate the various types of teams and teamwork practices.
- Apply mentoring, coaching, and trust-building techniques in team development.
- Solve the interrelationship between leader, follower, and situational factors.
- Apply ethical and value-based approaches to leadership practice.
- Analyze the strategies for effective leadership in global and multicultural environments.

TEXT BOOKS:

1. Hughes R L, Ginnett R C, and Curphy G J, "Leadership: Enhancing the Lessons of Experience", McGraw Hill Education, India, 9th Edition, 2019.
2. Katzenback J R and Smith D K, "The Wisdom of Teams: Creating the High Performance Organizations", Harvard Business Review Press, 2015.

REFERENCES:

1. Haldar U K, "Leadership and Team Building", Oxford University Press, 2010.
2. Daft R L, "The Leadership Experience", Cengage, 2023.
3. Daniel Levi, "Group Dynamics for Teams", Sage Publications, 4th Edition, 2014.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	-	-	-	-	1	2	2	-
CO2	2	1	-	-	2	2	-	1	2	2	2
CO3	2	1	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	2	2	-	1	3	2	2
CO5	2	1	1	1	2	2	-	1	3	2	2

CHAIRMAN
(BoS) MECH)

24M203	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the concepts, forms, and qualities of creativity along with the role of environment and personality.
- Know the concepts of traits, training methods, and barriers associated with creative intelligence.
- Study levels, types, and sectoral characteristics of innovation.
- Learn the concepts of innovation and entrepreneurship
- Explore entrepreneurial mindset, motivation, and opportunity analysis.

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.

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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: 45 PERIODS

OUTCOMES:

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

- Learn the differentiate between various forms of creativity and factors influencing creative performance.
- Apply creative tools, strategies, and techniques to overcome blocks to creativity.
- Solve theories of innovation and design thinking for practical application.
- Formulate the applications of innovation in building successful ventures
- Design responsible and sustainable business models for entrepreneurship.

TEXT BOOKS:

1. Khanka S S., "Creativity and Innovation in Entrepreneurship", Sultan Chand & Sons, 2021.
2. Pradip N Khandwalla, "Lifelong Creativity, An Unending Quest", Tata Mc Graw Hill, 2004.

REFERENCES:

1. Paul Trott, "Innovation Management and New Product Development", 4th Edition, Pearson, 2018.
2. Vinnie Jauhari and Sudanshu Bhushan, "Innovation Management", Oxford Higher Education, 2014.
3. Krishnamacharyulu C S G and Lalitha R, "Innovation Management"., Himalaya Publishing House, 2017.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	2	2	-	-	-	-	-
CO2	2	2	-	-	2	2	-	-	-	-	-
CO3	2	2	-	-	2	2	-	-	-	-	-
CO4	2	2	1	-	2	2	2	2	2	2	-
CO5	2	2	1	-	2	2		2	2	2	3

CHAIRMAN
(BoS / MECH)

24M204	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Realise the functions and orientations of marketing along with the traditional and modern marketing mix.
- Recognize the techniques of environmental scanning and the role of marketing research and information systems.
- Know the product life cycle strategies, product mix decisions, and branding practices.
- Investigate integrated marketing communication tools, personal selling process, and distribution channels.
- Learn modern practices like CRM, e-marketing, and services marketing in business contexts.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT **9**

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT **9**

Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT **9**

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBUTION MANAGEMENT **9**

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

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UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

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: 45 PERIODS

OUTCOMES:

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

- Illustrate the application in developing an effective marketing strategy.
- Compare micro and macro environment factors affecting marketing decisions.
- Formulate suitable pricing strategies for national and global markets.
- Explain the effective promotion and distribution strategies for various market segments..
- Apply strategies for managing customer loyalty, buyer–seller relationships, and online marketing initiatives.

TEXT BOOKS:

1. Sherlekar S A, "Marketing Management", Himalaya Publishing House, 2016.
2. Philip Kotler and Kevin Lane Keller, "Marketing Management", 15th Edition, Pearson, 2015.

REFERENCES:

1. Vijay Prakash Anand, "Marketing Management: An Indian Perspective", Biztantra, 2nd Edition, 2016.
2. Ramaswamy V S and Namakumari S, "Marketing Management: Global Perspective, Indian Context", Macmillan Publishers India, 5th Edition, 2015.
3. Dr. Gupta C B and Dr. Rajan Nair N, "Marketing Management: Text and Cases", 17th Edition, 2016.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	1	-	-	-	3	-	-
CO2	2	1	-	-	2	-	-	2	3	-	-
CO3	2	1	-	-	2	-	-	2	3	3	2
CO4	2	1	-	-	2	-	-	2	3	3	2
CO5	2	1	-	-	2	-	-	2	3	3	2

CHAIRMAN
(BoS / MECH)

24M205	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Describe the concepts, scope, and evolution of HRM along with the roles and challenges of HR managers.
- Understand the tools, methods, and recent trends in human resource planning and career management.
- Know the different sources, techniques, and processes of recruitment and selection in domestic and global contexts.
- Discover training types, compensation practices, and sustainable HR initiatives like Green HRM.
- Evaluate performance appraisal systems, grievance redressal methods, and employee relations practices.

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: 45 PERIODS

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OUTCOMES:

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

- Understand the Evolution of HRM and Challenges faced by HR Managers
- Apply HRIS and computer-based approaches in HR planning.
- Interpret employee engagement practices in relation to recruitment and selection.
- Apply effective training and development programs to enhance employee performance.
- Formulate HR strategies for conflict resolution, promotion, and union–management relations.

TEXT BOOKS:

1. Gary Dessler and Biju Varkkey, "Human Resource Management", Pearson, 16th Edition, 2020.
2. Mathis and Jackson, "Human Resource Management", Cengage Learning, 15th Edition, 2017.

REFERENCES:

1. David A Decenzo, Stephen P Robbins, and Susan L Verhulst, "Human Resource Management", Wiley, International Student Edition, 2014.
2. Aswathappa K, Sadhna Dash, "Human Resource Management - Text and Cases", McGraw Hill, 10th Edition, 2023.
3. Luis R Gomez-Mejia, David B Balkin, Robert L Cardy, "Managing Human Resource", PHI Learning, 2012

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	2	-	-	2	-
CO2	2	2	-	-	2	-	2	-	-	2	-
CO3	2	2	-	-	2	-	2	2	2	2	3
CO4	2	2	1	1	2	-	2	2	2	2	3
CO5	2	2	1	1	2	-	2	3	2	3	3

CHAIRMAN
(BoS / MECH)

24M206	FINANCING NEW BUSINESS VENTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the requirements, scope, and institutional support for setting up new ventures.
- Study the concepts, types, and challenges of venture financing
- Discuss the instruments and credit facilities involved in debt financing.
- Summarize the various equity-based funding options such as subsidies, angel investment, and venture capital.
- Explain the investor decision-making process and criteria for fund raising.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE **9**

Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING **9**

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING **9**

Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING **9**

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowd funding- 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: 45 PERIODS

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OUTCOMES:

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

- Classify different types of financing agencies and loan facilities available.
- Calculate project cost, working capital, and mix of debt–equity for financing..
- Select appropriate debt sources to manage capital and working capital needs.
- Construct financing plans using equity-based funding alternatives.
- Develop strategies for approaching and negotiating with potential investors.

TEXT BOOKS:

1. Brealey and Myers., "Principles of Corporate Finance", McGraw Hill Education (India) Private Limited, 12th Edition, 2018.
2. Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw Hill Education India Pvt Ltd, New Delhi, 2019.

REFERENCES:

1. Brad Feld and Jason Mendelson., "Venture Deals", John Wiley & Sons, Inc., 3rd Edition, 2016.
2. Josh Lerner, Ann Leamon, and Felda Hardymon, "Venture Capital, Private Equity, and The Financing of Entrepreneurship", 2023.
3. Thomas Byers, "Technology Ventures: From Idea to Enterprise", McGraw Hill Higher Education, 2025.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	1	1	1
CO2	2	-	-	-	-	-	-	1	2	2	2
CO3	2	2	-	-	1	1	2	1	2	2	2
CO4	2	2	-	-	1	1	2	1	2	2	2
CO5	2	2	1	1	1	1	2	1	2	2	2

CHAIRMAN
(BoS / MECH)

24M301	PRINCIPLES OF PUBLIC ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

Understand the nature of public administration.

- Learn the different functions of administration.
- Learn the different relationships and approaches.
- Understand the Bureaucratic and ecological approaches.
- Know about the leadership approaches, communication types and decision making process

UNIT-I INTRODUCTION TO PUBLIC ADMINISTRATION 9

1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration as a discipline
4. Public Administration and Governance

UNIT-II ADMINISTRATIVE THEORIES AND APPROACHES 9

1. Classical Approach – Henry Fayol, Luther Gulick
2. Scientific Management Approach – F.W. Taylor
3. Human Relations Approach – Elton Mayo
4. Bureaucratic Approach – Max Webe

UNIT-III RELATIONSHIP AND CONTEXT 9

1. Relationship of Public Administration with Political Science, History, Sociology, and Economics
2. Ecological Approach – F.W. Riggs
3. Comparative Public Administration
4. Role of Public Administration in Developing Countries

UNIT-IV NEW TRENDS IN PUBLIC ADMINISTRATION 9

1. New Public Administration (NPA)
2. New Public Management (NPM)
3. Governance and E-Governance
4. Public and Private Administration – Comparative Study

UNIT-V LEADERSHIP, COMMUNICATION AND DECISION MAKING 9

1. Leadership – Meaning, Styles and Theories
2. Communication – Types, Process, Barriers, Effective Communication in Administration
3. Decision Making – Concepts, Techniques and Models (Simon's Model, Rational and Participative Approaches)

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the nature. scope. and importance of public administration.
- Illustrate the evolution and various approaches to public administration.
- Analyze relationships of administration with other social sciences.
- Interpret the principles of leadership, communication, and decision making.
- Assess the new trends in public administration and their practical implications.

TEXT BOOKS:

1.Avasthi, A. and Maheshwari. S.R.. "Public Administration." Lakshmi Narain Agarwal. 18th Edition. 2022.

2.Nicholas Henry. "Public Administration and Public Affairs." Routledge. 14th Edition. 2023.

3.M.P. Sharma and B.L. Sadana, "Public Administration in Theory and Practice." Kitab Mahal. 2021.

REFERENCES:

1. Avasthi and Maheswari: Public Administration in India. Agra:Lakshmi Narain Agarwal.2013.
2. Ramesh K Arora: Indian Public Administration. New Delhi: Wishwa Prakashan. 2012.
3. R.B. Jain: Public Administration in India.21st Century Challenges for Good Governance, NewDelhi: Deep and Deep. 2002.
4. Rumki Basu: Public Administration:Concept and Theories. New Delhi:Sterling. 2013.
5. R. Tyagi. Public Administration, Atma Ram & Sons. New Delhi, 1983.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	2	3	2	–	–	2	2	3	-	3	3
CO3	2	2	–	–	–	3	2	2	-	2	3
CO4	2	3	3	3	3	3	3	3	2	3	3
CO5	3	2	2	–	–	3	3	3	2	3	3

CHAIRMAN
BOS/ECE

24M302	ELEMENTS OF PUBLIC ADMINISTRATION	L T P C
	(COMMON TO ALL BRANCHES)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the nature and role of public administration and the principles of good governance.
- Explore the interdisciplinary nature of public administration and key administrative approaches.
- Learn the foundational principles of organizational structure and administration.
- Understand administrative processes, leadership, and factors affecting organizational performance.
- Introduce personnel administration and the role of civil services in governance.

UNIT I ADMINISTRATION IN MODERN SOCIETY **9**

Administration in Modern Society; Pubic and Private administration; Evolution of the study of Public Administration. Concept of good governance.

UNIT II PUBLIC ADMINISTRATION AS A SOCIAL SCIENCE **9**

Public Administration as a social science; Relationship with other Social Sciences: Political Science, Economics, Sociology, Law and Psychology. Approaches to the study of Public Administration : Classical and Human Relation

UNIT III PRINCIPLES OF ORGANIZATION **9**

Principles of Organisations : Hierarchy, Unity of command, Span of control, Coordination, Centralisation, Decentralisation, Authority and Responsibility; Formal and Informal Organisation.

UNIT IV ADMINISTRATIVE PROCESSES **9**

Chief Executive, Line and Staff, Supervision, Delegation, Leadership, Communication, Decision making , Morale and Motivation .

UNIT V PERSONNEL ADMINISTRATION **9**

Personnel Administration : Meaning and nature of Bureaucracy; Civil Services and their role in a developing society; Classification, Recruitment, Training, Promotion, Disciplinary action, code of conduct..

TOTAL: 45 PERIODS

OUTCOMES:

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

- Differentiate between public and private administration.
- Analyze the interdisciplinary aspects of public administration.
- Apply principles of organization in administrative systems.
- Evaluate administrative processes including leadership, communication, and decision-making.
- Explain personnel administration, civil services, and ethical responsibilities.

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TEXT BOOKS

1. Avasthi. A. and Maheshwari. S.R.. "Public Administration." Lakshmi Narain Agarwal. 18th Edition. 2022.
2. M.P. Sharma and B.L. Sadana. "Public Administration in Theory and Practice." Kitab Mahal. 2021.
3. Nicholas Henry. "Public Administration and Public Affairs." Routledge. 14th Edition. 2023.

REFERENCES:

1.F.W. Riggs. "Ecology of Public Administration." Asia Publishing House. 2021.
Peter Self. "Administrative Theories and Politics." Routledge. 2nd Edition. 2019.

2. Dwivedi. O.P. and Gow. J.I.. "From Bureaucracy to Public Management." Broadview Press. 2020.
3. L.D. White. "Introduction to the Study of Public Administration," Macmillan. Reprint Edition. 2020.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	2	3	2	–	–	2	2	3	-	3	3
CO3	2	2	–	–	–	3	2	2	-	2	3
CO4	2	3	3	3	3	3	3	3	2	3	3
CO5	3	2	2	–	–	3	3	3	2	3	3

CHAIRMAN
BOS/ECE

24M303	PUBLIC PERSONNEL ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the concept, scope, and significance of personnel administration in public administration.
- Learn the structure and functioning of civil services and bureaucracy.
- Study recruitment, training, promotion, and disciplinary mechanisms in public service.
- Understand the role of ethics, code of conduct, and accountability in personnel administration.
- Examine contemporary issues, challenges, and reforms in personnel management in government.

UNIT-I INTRODUCTION TO PUBLIC PERSONNEL ADMINISTRATION **9**

1. Meaning, Nature, and Scope of Personnel Administration
2. Importance and Functions of Personnel Administration
3. Relationship between Personnel Administration and Public Administration
4. Principles of Effective Personnel Management

UNIT-II BUREAUCRACY AND CIVIL SERVICES **9**

1. Bureaucracy: Meaning, Nature, and Features
2. Role of Civil Services in Governance and Development
3. Classification of Civil Services: Central and State Services
4. Functions and Responsibilities of Civil Servants

UNIT-III RECRUITMENT AND TRAINING **9**

1. Recruitment: Methods and Procedures in Public Services
2. Selection Process and Entry-Level Requirements
3. raining and Development Programs for Civil Servants
4. Performance Appraisal and Career Development

UNIT-IV PROMOTION, DISCIPLINE AND ACCOUNTABILITY **9**

1. Promotion Policies and Procedures in Public Services
2. Disciplinary Action: Principles and Procedures
3. Code of Conduct for Civil Servants
4. Accountability and Transparency in Public Personnel Administration

UNIT-V CONTEMPORARY ISSUES AND REFORMS **9**

1. Challenges in Public Personnel Administration
2. Recruitment Reforms and Modernization of Civil Services
3. E-Governance and Digitalization in Personnel Management
4. International Best Practices and Comparative Perspectives

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the nature, scope, and functions of public personnel administration
- Describe the role of bureaucracy and civil services in governance
- Analyze recruitment, training, and career development processes
- Evaluate promotion, disciplinary measures, and accountability mechanisms
- Assess contemporary challenges, reforms, and digitalization in personnel administration

TEXT BOOKS

1.M.P. Sharma and B.L. Sadana, "Public Administration in Theory and Practice," Kitab Mahal, 2021.

2.Avasthi, A. and Maheshwari, S.R., "Public Administration," Lakshmi Narain Agarwal, 18th Edition, 2022.

3. Nicholas Henry, "Public Administration and Public Affairs," Routledge, 14th Edition, 2023.

REFERENCES:

1.F.W. Riggs, "Ecology of Public Administration," Asia Publishing House, 2021.

2.Peter Self, "Administrative Theories and Politics," Routledge, 2nd Edition, 2019.

3.Dwivedi, O.P., "Bureaucracy and Civil Services in India," Sterling Publishers, 2020.

4.L.D. White, "Introduction to the Study of Public Administration," Macmillan, Reprint Edition, 2020.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	3	2	-	–	–	2	2	2	-	2	3
CO3	2	3	2	–	–	3	2	3	-	3	3
CO4	2	3	3	3	3	3	3	3	2	3	3
CO5	3	2	2	2	3	3	3	3	2	3	3

CHAIRMAN
BOS/ECE

24M304	ADMINISTRATIVE THEORIES (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the historical development and evolution of administrative thought.
- Learn classical, behavioral, and modern approaches to administration.
- Examine the contributions of key theorists in administrative theory.
- Understand organizational principles, processes, and structures.
- Analyze contemporary trends and emerging theories in public administration.

UNIT I INTRODUCTION TO ADMINISTRATIVE THEORIES 9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II CLASSICAL APPROACHES 9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT III BEHAVIORAL APPROACHES 9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV MODERN AND CONTEMPORARY APPROACHES 9

Systems Theory, Contingency Approach, Total Quality Management (TQM), New Public Administration (NPA) and New Public Management (NPM)

UNIT V ORGANIZATIONAL THEORY AND EMERGING TRENDS 9

Organizational Culture and Climate, Network Governance and E-Governance, Knowledge Management in Administration, Comparative Public Administration and Global Practices.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the evolution and significance of administrative theories
- Compare classical administrative approaches and their relevance

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- Evaluate behavioral approaches including human relations and decision-making
- Analyze modern administrative theories and management techniques
- Assess organizational theories, emerging trends, and global practices

TEXT BOOKS:

1. M.P. Sharma and B.L. Sadana, "Public Administration in Theory and Practice," Kitab Mahal, 2021.
2. Avasthi, A. and Maheshwari, S.R., "Public Administration," Lakshmi Narain Agarwal, 18th Edition, 2022.
3. Nicholas Henry, "Public Administration and Public Affairs," Routledge, 14th Edition, 2023.

REFERENCES:

1.F.W. Riggs, "Ecology of Public Administration," Asia Publishing House, 2021.
2.Peter Self, "Administrative Theories and Politics," Routledge, 2nd Edition, 2019.
3.Dwivedi, O.P., "Bureaucracy and Civil Services in India," Sterling Publishers, 2020.
4. L.D. White, "Introduction to the Study of Public Administration," Macmillan, Reprint Edition.2020.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	2	2	2	–	–	2	2	3	-	3	3
CO3	2	3	2	3	3	3	2	3	2	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3
CO5	3	2	2	2	3	3	3	3	2	3	3

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24M305	INDIAN ADMINISTRATIVE SYSTEM (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the structure, functions, and evolution of the Indian Administrative System.
- Learn about the Union and State governments, their institutions, and functioning.
- Understand the roles, powers, and responsibilities of civil servants in India.
- Examine administrative processes, decision-making, and accountability mechanisms in governance.
- Explore reforms, contemporary issues, and challenges in Indian administration.

UNIT I INTRODUCTION TO INDIAN ADMINISTRATIVE SYSTEM **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 UNION GOVERNMENT AND ADMINISTRATION **9**

Structure and Functions of the Union Government, President, Prime Minister, Council of Ministers: Powers and Responsibilities, Parliament and its Role in Administration, Ministries and Departments: Functions and Coordination

UNIT III STATE GOVERNMENT AND ADMINISTRATION **9**

Structure and Functions of State Governments, Governor, Chief Minister, State Council of Ministers: Powers and Responsibilities, State Legislature and Administrative Machinery, Local Self-Government: Panchayati Raj and Urban Local Bodies

UNIT IV CIVIL SERVICES IN INDIA **9**

Bureaucracy: Meaning, Features, and Role in Governance, Union and State Civil Services: IAS, IPS, and Other Services, Recruitment, Training, Promotion, and Performance Evaluation, Accountability, Ethics, and Conduct of Civil Servants.

UNIT V REFORMS AND CONTEMPORARY ISSUES **9**

Administrative Reforms: Recommendations and Implementation, E-Governance, Digital India, and Transparency Initiatives, Challenges in Indian Administration: Corruption, Red-Tapism, and Policy Implementation, Comparative Administrative Practices and Global Perspectives

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the evolution and constitutional basis of Indian administration
- Describe the structure, roles, and responsibilities of Union Government institutions
- Analyze state government structures and local self-governance mechanisms
- Explain the role, recruitment, and accountability of civil services in India
- Evaluate administrative reforms, e-governance, and contemporary challenges

TEXT BOOKS

1. M.P. Sharma and B.L. Sadana, "Public Administration in Theory and Practice," Kitab Mahal, 2021.
2. Avasthi, A. and Maheshwari, S.R., "Public Administration," Lakshmi Narain Agarwal, 18th Edition, 2022.
3. Laxmikanth, M., "Public Administration," McGraw-Hill, 2022.

REFERENCES:

1. Subhash Kashyap, "Indian Administration," National Book Trust, 2020.
2. Peter Self, "Administrative Theories and Politics," Routledge, 2nd Edition, 2019.
3. F.W. Riggs, "Ecology of Public Administration," Asia Publishing House, 2021.
4. Vig, N., "Indian Civil Services and Governance," Sage Publications, 2021.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	3	2	-	–	–	2	2	2	-	2	2
CO3	2	3	2	-	-	3	2	3	2	3	3
CO4	3	2	2	-	-	3	3	3	2	3	3
CO5	3	2	2	2	3	3	3	3	2	3	3

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24M306	PUBLIC POLICY ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the concepts, nature, and scope of public policy and its role in governance.
- Learn the stages of policy formulation, implementation, and evaluation.
- Examine the role of institutions, bureaucracy, and leadership in policy-making.
- Analyze the tools and techniques for effective policy implementation.
- Evaluate contemporary policy issues, reforms, and challenges in governance

UNIT-I INTRODUCTION TO PUBLIC POLICY 9

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Publicpolicy relationship with social sciences especially with political science and Public Administration.

UNIT-II POLICY FORMULATION 9

Actors in Policy-Making: Government, Bureaucracy, Interest Groups, and Media- Stages of Policy Formulation: Agenda Setting, Policy Design, and Decision Making- Tools and Techniques for Policy Formulation- Challenges in Policy Formulation

UNIT-III POLICY IMPLEMENTATION 9

Bureaucracy and Policy Implementation- Administrative Structures and Coordination- Leadership and Decision-Making in Implementation- Obstacles to Effective Implementation: Red-Tapism, Corruption, and Resource Constraints

UNIT-IV POLICY EVALUATION AND CONTROL 9

Methods and Techniques of Policy Evaluation- Performance Measurement and Monitoring- Feedback Mechanisms and Policy Adjustments- Role of Legislative, Judicial, and Executive Oversight

UNIT-V CONTEMPORARY ISSUES IN PUBLIC POLICY 9

Social Policy: Health, Education, and Welfare Programs- Economic Policy: Fiscal, Monetary, and Industrial Policies- Environmental Policy and Sustainable Development- Policy Reforms, E-Governance, and Global Best Practices

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain the nature, scope, and significance of public policy
- Analyze the stages and actors in policy formulation
- Describe policy implementation mechanisms and challenges
- Evaluate policy outcomes using methods and feedback mechanisms
- Assess contemporary policy issues, reforms, and best practices

TEXT BOOKS:

1. Thomas R. Dye, "Understanding Public Policy," Pearson, 15th Edition, 2020.
2. DeLeon, Public Policy: Theory and Practice, Routledge, 2nd Edition, 2019.
3. M.P. Sharma and B.L. Sadana, "Public Administration in Theory and Practice," Kitab Mahal, 2021.

REFERENCES:

1. James E. Anderson, "Public Policy: An Introduction to the Theory and Practice," Cengage, 9th Edition, 2021.
2. Subhash Kashyap, "Public Policy and Governance in India," National Book Trust, 2020.
3. Peter Hupe and Michael Hill, "Implementing Public Policy," Sage Publications, 2019.
4. F.W. Riggs, "Ecology of Public Administration," Asia Publishing House, 2021.

MAPPING OF COs WITH POs

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	-	2	2	2	-	2	2
CO2	2	3	2	–	–	2	2	3	-	3	3
CO3	3	2	2	-	-	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3
CO5	3	2	2	2	3	3	3	3	2	3	3

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BOS/ECE

24M401	STATISTICS FOR MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand basic probability and common types of distributions
- Learn how to take samples and estimate values for a population
- Use statistical tests like z-test, t-test, and ANOVA to test idea
- Know about different tests for analytics
- Find and explain relationships between two or more variable

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: 45 PERIODS

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OUTCOMES:

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

- Facilitate objective solutions in distribution techniques
- Estimate population values from samples
- Test hypotheses using parametric methods
- Develop skill-set that is in demand in both the research and business environments
- Measure correlation and build regression lines

TEXT BOOKS:

1. Richard I Levin, David S Rubin, Masood H Siddiqui, Sanjay Rastogi, "Statistics for Management", Pearson Education, 8th Edition, 2017.
2. Ken Black, "Applied Business Statistics", 7th Edition, Wiley India Edition, 2012.

REFERENCES:

1. Prem S Mann, "Introductory Statistics", Wiley Publications, 9th Edition, 2015.
2. Srivastava T N and Shailaja Rego, "Statistics for Management", Tata McGraw Hill, 3rd Edition 2017.
3. 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.
4. Vohra N D, "Business Statistics", Tata McGraw Hill, 2017.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	2	2	2	-	2	2
CO2	2	2	2	-	-	2	1	1	-	2	2
CO3	2	2	1	-	-	2	-	2	-	2	2
CO4	2	2	2	-	-	1	1	1	-	2	2
CO5	2	2	2	-		1	-	2	-	1	2

CHAIRMAN
BoS (AD)

24M402	DATA MINING FOR BUSINESS INTELLIGENCE	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the basics of data mining and warehousing
- Learn different data mining processes and models
- Explore data visualization and time series methods
- Study techniques to group and classify data
- Understand key AI techniques used in data mining

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, Fuzzy logic, Ant Colony optimization, Particle Swarm Optimization

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the uses of data mining, text mining, web mining, and data warehouses
- Describe KDD, CRISP-DM, and SEMMA with prediction performance measures
- Apply ARIMA and Winter's method for time-based predictions
- Use classification, association, and clustering methods in data analysis
- Develop and implement machine learning algorithms

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TEXT BOOKS:

1. Ralph Kimball and Richard Merz, "The data warehouse toolkit", John Wiley, 3rd Edition, 2013.
2. Galit Shmueli, Nitin R Patel and Peter C Bruce, "Data Mining for Business Intelligence-Concepts, Techniques and Applications", Wiley, India, 2010.

REFERENCES:

1. Jaiwei Ham and Micheline Kamber, "Data Mining concepts and techniques", Kauffmann Publishers2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, "Business Intelligence", Prentice Hall, 2008.
3. Inmon W H, "Building the Data Warehouse", fourth Edition Wiley India pvt. Ltd. 2005.
4. Michel Berry and Gordon Linoff, "Mastering Data mining", John Wiley and Sons Inc, 2nd Edition, 2011.
5. Michel Berry and Gordon Linoff, "Data mining techniques for Marketing", Sales and Customer support, John Wiley, 2011.
6. Gupta G K, "Introduction to Data mining with Case Studies", Prentice hall of India, 2011
7. Giudici, "Applied Data mining – Statistical Methods for Business and Industry", John Wiley, 2009.
8. Elizabeth Vitt, Michael Luckevich Stacia Misner, "Business Intelligence", Microsoft, 2011.
9. Michalewicz Z, Schmidt M Michalewicz M and Chiriac C, "Adaptive Business Intelligence", Springer Verlag, 2007.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	2	-	2	2	2	2
CO2	3	2	2	2	3	1	-	1	1	2	2
CO3	3	2	2	2	3	2	-	2	1	2	2
CO4	3	2	1	2	3	1	-	1	2	2	2
CO5	3	2	1	1	3	1	-	2	2	1	2

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BoS (AD)

24M403	HUMAN RESOURCE ANALYTICS	L T P C
		3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the role of people analytics and HR metrics in business impact
- Learn key recruitment metrics and their use in hiring analysis
- Understand how to measure and evaluate training effectiveness
- Study analytics for employee engagement and internal career movement
- Explore metrics for workforce diversity and structure analysis

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 PROGRESSION **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**

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling - Churn over index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain stages of HR analytics maturity and identify key HR KPIs
- Calculate and interpret metrics like time to hire, cost per hire, and quality of hire
- Apply training metrics such as training hours, cost per employee, and ROI
- Use metrics like retention index, promotion index, and career path index
- Analyze diversity using gender mix, churn rate, and age/service profilin

TEXT BOOKS:

1. Edwards M R., & Edwards K, "Predictive HR Analytics: Mastering the HR Metric", London: Kogan Page, 2016.
2. Dipak Kumar Bhattacharyya, "HR Analytics Understanding Theories and Applications", SAGE Publications India, 2017.

REFERENCES:

1. Jac Fitzenz, "The New HR Analytics", AMACOM, 2010.
2. "Human Resources kit for Dummies", 3rd Edition, Max Messmer, 2003.
3. Sesil J C, "Applying advanced analytics to HR management decisions: Methods for selection, developing incentives, and improving collaboration. Upper Saddle River", New Jersey: Pearson Education, 2014.
4. Pease G, & Beresford B, "Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments", Wiley, 2014.
5. Phillips J, & Phillips P P, "Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME", McGraw-Hill, 2014.
6. "HR Scorecard and Metrices", HBR, 2001.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	2	-	1	2	2	2	2
CO2	2	2	2	2	1	-	1	1	1	2	2
CO3	2	1	2	1	1	-	1	2	1	2	2
CO4	2	1	1	2	1	-	1	1	2	2	2
CO5	2	1	2	1	1	-	1	2	2	1	2

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BoS (AD)

24M404 MARKETING AND SOCIAL MEDIA WEB ANALYTICS **L T P C**
3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand key marketing performance metrics and data analysis tools
- Learn how social media evolved and how it supports community engagement
- Understand social media ethics, privacy, and tracking methods
- Explore tools and methods for analyzing web data and business KPIs
- Study techniques to analyze and optimize online search and user behavior

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: 45 PERIODS

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OUTCOMES:

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

- Use techniques like market basket analysis and geo-mapping to interpret marketing data
- Identify social media goals, audiences, influencers, and promotional strategies
- Apply social media policies and measure platform performance responsibly
- Collect, interpret, and report web data to support digital strategy decisions
- Apply SEO, traffic analysis, and data visualization to improve online performance

TEXT BOOKS:

1. Takeshi Moriguchi, "Web Analytics Consultant Official Textbook", 7th Edition, 2016.
2. Christian Fuchs, "Social Media a critical introduction", SAGE Publications Ltd, 2014.

REFERENCES:

1. Shrivastava K M, "Social Media in Business and Governance", Sterling Publishers Private Limited, 2013.
2. Bittu Kumar, "Social Networking", V & S Publishers, 2013.
3. Avinash Kaushik, "Web Analytics An Hour a Day", Wiley Publishing, 2007.
4. Ric T Peterson, "Web Analytics Demystified", Celilo Group Media and Café Press 2004.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	3	1	-	2	2	2	2
CO2	3	2	2	2	2	1	-	1	1	1	1
CO3	3	3	2	2	2	1	-	2	1	2	2
CO4	3	2	3	2	2	1	-	1	2	2	2
CO5	3	2	2	1	2	1	-	2	2	1	1

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24M405 OPERATION AND SUPPLY CHAIN ANALYTICS **L T P C**
3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand types of analytics and their role in supply chains
- Learn models and methods for warehouse location and layout
- Study inventory models and risk management in supply chains
- Explore optimization algorithms for transportation and scheduling
- Understand multi-criteria decision-making techniques

UNIT I INTRODUCTION **9**

Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains - Basics, transforming supply chains.

UNIT II WAREHOUSING DECISIONS **9**

P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III INVENTORY MANAGEMENT **9**

Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS **9**

Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.

UNIT V MCDM MODELS **9**

Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Explain descriptive. predictive. and prescriptive analytics and their application in supply chain transformation
- Apply P-Median. LP. and heuristic approaches for warehouse space and layout decisions
- Implement lot sizing. multi-echelon inventory. and risk pooling strategies
- Solve problems using shortest path. maximal flow. traveling salesman. and scheduling algorithms
- Apply AHP. DEA. Fuzzy Logic. ANP. and TOPSIS in supply chain decisions

TEXT BOOKS:

1. Gerhard J Plenert. "Supply Chain Optimization through Segmentation and Analytics", CRC Press. Taylor & Francis Group. 2014.
2. Muthu Mathirajan. Chandrasekharan Rajendran. Sowmyanarayanan Sadagopan. Arunachalam Ravindran. Parasuram Balasubramanian. "Analytics in Operations/Supply Chain Management". I.K. International Publishing House Pvt. Ltd.. 2016.

REFERENCES:

1. Nada R Sanders. "Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence". Pearson Education. 2014.
2. Michael Watson. Sara Lewis. Peter Cacioppi. Jay Jayaraman. "Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain". Pearson Education. 2013.
3. Anna Nagurney. Min Yu. Amir H Masoumi. Ladimer S Nagurney. "Networks Against Time: Supply Chain Analytics for Perishable Products". Springer. 2013.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	2	-	-	-	2	1	2	2
CO2	2	2	2	2	-	-	-	1	1	2	2
CO3	2	2	1	2	-	-	-	1	1	2	1
CO4	2	2	1	2	-	-	-	1	1	1	1
CO5	2	2	1	1	-	-	-	1	1	1	1

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BoS (AD)

24M406	FINANCIAL ANALYTICS	L T P C
		3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand financial modeling and capital budgeting techniques
- Learn risk and return estimation using time series models
- Explore portfolio management and option pricing models
- Use charting and indicators to predict stock prices
- Understand credit risk evaluation techniques

UNIT I CORPORATE FINANCE ANALYSIS **9**

Basic corporate financial predictive modeling - 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: 45 PERIODS

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OUTCOMES:

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

- Perform cash flow analysis and apply payback, NPV, and IRR methods
- Analyze bond and stock investments using ARMA, ARCH, GARCH models and Value at Risk
- Apply CAPM, Sharpe ratio, binomial and Black-Scholes models in portfolio analysis
- Analyze share prices using RSI, MACD, moving averages, and simulate trading strategies
- Build and evaluate credit risk models using decision trees and logistic regression

TEXT BOOKS:

1. Yuxing Yan, "Python for Finance", Paperback - Import, 30 Jun 2017.
2. James Ma Weiming "Mastering Python for Finance Paperback", Import, 29 Apr 2015.

REFERENCES:

1. Mark J Bennett, Dirk L Hugen, "Financial analytics with R", Cambridge University Press.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Paperback – Import, 25 Oct 2013.
3. Edward E Williams, John A Dobelman "Quantitative Financial Analytics: The Path to Investment Profits Paperback", Import, 11 Sep 2017.

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	2	-	-	-	2	2	1	2
CO2	2	2	2	2	-	-	-	1	1	2	2
CO3	2	2	2	1	-	-	-	2	1	1	1
CO4	2	2	1	1	-	-	-	1	2	1	2
CO5	2	1	2	2	-	-	-	2	2	1	1

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24M501	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Gain knowledge on sustainable development goals and practices.
- Understand the concepts involved in sustainable infrastructure planning.
- Acquire knowledge on design, construction practices and techniques in construction.
- Explore the construction materials required for sustainable construction.
- Assess various measures for sustainable maintenance 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 –

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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

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS **9**

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS **9**

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the environment sustainability goals at global and Indian scenario.
- Recognize risks in development of projects and suggest mitigation measures.
- Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
- Explain Life cycle analysis and life cycle cost of sustainable construction materials.
- Explore the new technologies adopted for maintenance of infrastructure projects.

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REFERENCES:

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4thEdition, 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. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
7. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing, 2009.
8. 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.
9. Greger Lundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	2	-	-	-	-	-
CO2	2	-	-	-	-	2	-	-	-	-	-
CO3	2	-	-	-	-	2	-	-	-	-	-
CO4	2	-	2	-	-	2	-	-	-	-	-
CO5	2	-	-	-	-	2	-	-	-	2	-

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24M502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the issues of sustainability in agro ecology, agro ecosystem.
- Study soil health, soil erosion, control measures and suggest the management practices to improve soil nutrition.
- Explore the techniques needed for water management which leads to efficient storage system.
- Identify types and sources of agricultural wastes and suggest the suitable technologies for its sustainable management.
- Evaluate proper techniques adopted for sustainable food production.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS **9**

Ecosystem definition - Biotic *Vs.* abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT **9**

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT **9**

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

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UNIT IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explore the knowledge about the concepts, principles and advantages of sustainable agriculture.
- Discuss the sustainable ways in managing soil health, nutrients, pests and diseases.
- Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources.
- Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas.
- Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem.

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive 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
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	3	-	-	-	-	-
CO2	2	-	-	-	-	3	-	-	-	1	-
CO3	2	-	-	-	-	3	-	-	-	1	-
CO4	2	-	-	-	-	3	-	-	-	1	-
CO5	2	-	-	-	-	3	-	-	-	-	-

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24M503	SUSTAINABLE BIO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Impart knowledge on biomaterials and their properties.
- Recognize the fundamentals aspects, types of biopolymers and its applications.
- Learn about the properties of bio ceramics and bio composites.
- Discuss biomedical metals, with its types, properties and applications.
- Understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS **9**

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure- surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT II BIO POLYMERS **9**

Molecular structure of polymers -Molecular weight - Types of polymerization techniques– Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers – Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications.

UNIT III BIO CERAMICS AND BIOCOMPOSITES **9**

General properties- Bio ceramics -Silicate glass - Alumina (Al_2O_3) -Zirconia (ZrO_2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite (PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

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UNIT IV METALS AS BIOMATERIALS **9**

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V NANOBIOMATERIALS **9**

Meatllic nanobiomaterials– Nanopolymers –Nanoceramics - Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize- nanofibres -Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics - Nanomedicines- Biochips – Biomimetics - BioNEMs -Biosensor- Bioimaging/Molecular Imaging - challenges and future perspective.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Impart knowledge on surface properties, adhesion and performance of biomaterials.
- Analyze an overview of polymerization techniques, reactions of various biopolymers.
- Enhance the importance and properties of different bio ceramics and bio composite materials.
- Acquire knowledge on metals as biomaterials.
- Apply nano biomaterials in biomedical and other applications.

REFERENCES:

1. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad "Functional Bionanomaterials" springer, 2020.
2. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani "Introduction to Biomaterials Basic Theory with Engineering Applications" Cambridge University Press, 2014.
3. Donglu shi "Introduction to Biomaterials" Tsinghua University press, 2006.
4. Joon Park, R.S.Lakes "Biomaterials An Introduction" third edition, Springer 2007.
5. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh "Characterization of Biomaterials" Wood head publishing, 2013.
6. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.
7. Leopoido Javier Rios Gonzalez. "Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process" Apple academic press, 2021.
8. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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CO2	3	-	-	-	-	3	-	-	-	-	-
CO3	3	-	-	-	2	3	-	-	-	-	-
CO4	3	-	-	-	2	3	-	-	-	-	-
CO5	3	-	-	-	2	3	-	-	-	-	-

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24M504	MATERIALS FOR ENERGY SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the challenges and demands of sustainable energy sources.
- Gain fundamental knowledge about electrochemical devices and materials.
- Classify the various types of fuel cells.
- Illustrate the novel materials and their usage in photovoltaic application.
- Identify the basic principles of various types of supercapacitors and types of nano composites used in SC electrodes.

UNIT I SUSTAINABLE ENERGY SOURCES **9**

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES **9**

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT III FUEL CELLS **9**

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting)– Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

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UNIT IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis -benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine).

UNIT V SUPERCAPACITORS 9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell- parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Acquire knowledge about various sources of energy sustainability.
- Understand the principles of different electrochemical devices.
- Examine the working principle of fuel cells and their applications.
- Summarize the various photovoltaic applications and the materials used.
- Gain knowledge on different types of supercapacitors and the performance of various materials.

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REFERENCES:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and Venkataraman Thangadurai, J. Mater. Chem. A, 2022.
3. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
4. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
5. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
6. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
7. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	1	3	-	-	-	-	-
CO2	3	-	-	-	1	2	-	-	-	-	-
CO3	3	-	-	-	1	2	-	-	-	-	-
CO4	3	-	-	-	1	2	-	-	-	-	-
CO5	3	-	-	-	1	2	-	-	-	-	-

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24M505	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Acquire knowledge on green chemistry and its applications.
- Identify the types of pollution and its sources.
- Classify solvents, green reagents and study the design process of chemical and microwave methods.
- Interpret the real time analysis for prevention of pollution and to provide green engineering solutions to reduce carbon foot print.
- Infer knowledge on nano materials and green nano technology.

UNIT I PRINCIPLES OF GREEN CHEMISTRY **9**

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES **9**

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS **9**

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES **9**

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention.

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UNIT V GREEN NANOTECHNOLOGY 9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the principles of green engineering and technology.
- Learn different types of waste, chemical, physical and biochemical methods of waste minimization.
- Modify processes and products to make them green and safe through green synthesis and green reagents.
- Design safe products through green process to prevent pollution using green technology.
- Apply advanced green nanotechnology in green synthesis to reduce environmental impacts.

TEXT BOOKS:

1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, 1997

2. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.

3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008

REFERENCES:

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	3	-	-	-	-	-
CO2	3	-	-	-	-	3	-	-	-	-	-
CO3	3	-	-	-	-	3	-	-	-	-	-
CO4	3	-	-	-	-	3	-	-	-	-	-
CO5	3	-	-	-	2	3	-	-	-	-	-

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24M506	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the concepts of environmental monitoring and standards.
- Study the complexity of the environmental parameters through monitoring programme.
- Analyze the organic pollutants and quality through environmental analysis and monitoring by proper methods.
- Evaluate environmental monitoring programme and risk assessment.
- Identify the automated data acquisition for process monitoring and control.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

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UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol - Process of risk assessment- hazard identification-exposure assessment- dose-response assessment - risk characterization.

UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING 9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control - regulatory overview.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand environmental quality standards in India.
- Analyze current environmental issues, sampling methods and monitoring techniques.
- Identify the various instrumental methods and their principles for environmental monitoring.
- Enrich the significance of environmental standards through environmental monitoring programme.
- Study types and systems of data acquisition systems and processing.

TEXTBOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, 2002 by The McGraw-HillCompanies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, 1997 by CRC Press, Inc

REFERENCES:

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	2	2	-	-	-	-
CO2	2	-	-	-	1	2	-	-	-	-	-
CO3	2	-	-	-	1	2	-	-	-	-	-
CO4	2	-	-	-	-	2	-	-	-	-	-
CO5	2	2	-	-	-	2	-	-	-	-	-

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24M507	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Create awareness on the energy scenario of India with respect to world.
- Understand the fundamentals of energy sources, energy efficiency and environmental standards.
- Familiarization on the concept of sustainable development goal and its benefits.
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development.
- Identify the suitable energy policies for sustainable development.

UNIT I ENERGY SCENARIO **9**

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT **9**

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III REMEDIAL OPTIONS **9**

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) -Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Incomeand growth.

UNIT IV RENEWABLE ENERGY TECHNOLOGY **9**

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits.

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UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT 9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority- National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the world and Indian energy scenario.
- Analyse energy projects, its impact on environment and suggest control strategies.
- Recognise the need of sustainable development and its impact on human resource development
- Apply renewable energy technologies for sustainable development.
- Categorize energy policies and planning for sustainable development.

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert Ristirer and Jack P. Kraushaar, "Energy and the environment", Willey, 2005.
3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
4. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press,2006.
6. M.H. Fulekar, Bhawana Pathak,R K Kale, "Environment and Sustainable Development" Springer,2016
7. https://www.niti.gov.in/verticals/energy

Mapping of COs with POs

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CO3	2	-	-	-	-	2	-	-	-	-	-
CO4	2	-	-	-	2	2	-	-	-	-	-
CO5	2	-	-	-	-	2	2	-	-	-	-

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28.10.22

24M508	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the types of energy sources, energy efficiency and environmental implications of energy utilization.
- Create awareness on energy audit and its impacts.
- Categorize the techniques adopted for performance evaluation of energy efficiency in thermal utilities.
- Familiarize on the procedures adopted for energy conservation in electrical utilities.
- Identify the concepts of attaining sustainable development and social development goals.

UNIT I ENERGY AND ENVIRONMENT **9**

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING **9**

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES **9**

Energy conservation avenues in steam generation and utilization, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermo compression.

UNIT IV ENERGY CONSERVTION IN ELECTRICAL UTILITIES **9**

Demand side management - Power factor improvement – Energy efficient transformers – Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

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UNIT V SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG).Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Gain knowledge on the prevailing energy scenario.
- Familiarise on energy audits and its relevance.
- Apply the concept of energy efficiency on thermal utilities.
- Identify the energy efficient conservation techniques in various electrical utilities.
- Explore sustainable development and its impact on human resource development.

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4th Edition, Wiley,2022
3. Eastop. T.D& Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, ISBN-0-582-03184, 1990
4. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
5. Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New IndiaPublishing Agency- Nipa,2020
6. Matthew John Franchetti, Defne Apul "Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies" CRC Press,2012
7. M.H. Fulekar, Bhawana Pathak, R K Kale, "Environment and Sustainable Development" Springer,2016
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	2	-	-	-	-	-
CO2	3	-	-	-	-	2	3	-	-	-	-
CO3	3	-	-	-	-	2	-	-	-	-	-
CO4	3	-	-	-	-	2	-	-	-	-	-
CO5	3	-	-	-	-	2	-	-	-	-	-

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