M.I.E.T. ENGINEERING COLLEGE

(Autonomous)
Tiruchirappalli-620007

Curriculum & Syllabus

(Regulations 2024)



B.E. Biomedical Engineering

M.I.E.T. ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Accredited by NBA (CIVIL, CSE, ECE, EEE & MECH)
Accredited with 'A+' grade by NAAC
(An ISO 9001:2015 Certified Institution)
(Recognized by UGC under section 2(f) & 12(B) of UGC Act, 1956)
TRICHY - PUDUKKOTTAI MAIN ROAD, TRICHY - 620 007

DEPARTMENT OF BIOMEDICAL ENGINEERING



CURRICULUM AND SYLLABUS

B.E BIOMEDICAL ENGINEERING
(Regulation 2024)

Vision

To emerge as a premier hub of Biomedical Engineering education and research, driving transformative healthcare innovations through technical expertise, ethical integrity and professional excellence for the betterment of society and the nation.

Mission

- To foster innovation, research, and industry collaboration in the development of medical devices, diagnostic tools and therapeutic solutions.

- To nurture ethical values, empathy, and social responsibility among students for addressing the diverse healthcare needs of society.

- To equip graduates with technical expertise and professional skills to excel in careers across biomedical industries, research and clinical applications.

Programme Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research - based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

1. Design and develop medical devices adhering to the ethics and standards in enhancing the quality of life.
2. Apply information and communication technologies (ICT) along with software skills to develop indigenous medical instruments that are on par with the existing technology.

Programme Educational Objectives (PEOs)

1. To apply technical skills and knowledge in providing biomedical engineering solution for enhancing human life.
2. To integrate engineering and biomedical sciences to develop innovative healthcare solutions.
3. To pursue multidisciplinary research, drive innovation and advancements in biomedical engineering.

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Mapping of PEOs with POs and PSOs

PEOs	PO1	PO2	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	-	2	2	-	2	-	-	-	-	3	3
PEO2	3	2	2	2	3	3	3	2	3	-	2	3	3
PEO3	3	3	3	3	2	3	3	3	3	3	3	3	3

1 - Low, 2 - Medium, 3 – High

CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24IP1101	Induction Programme	-	-	-	-	-	0
2.	24HS1101	Professional English	HSMC	3	0	2	5	4
3.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
4.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
5.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
6.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
7.	24GE1102	Heritage of Tamils தமிழர் மரபு	HSMC	1	0	0	1	1
8.	24GE1201	Professional Development	ESC	0	0	4	4	2
			Total	**16**	**1**	**12**	**29**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
2.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	24PH2101	Material Science	BSC	3	0	0	3	3
4.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
5.	24GE2102	Fundamentals of Building and Mechanical Sciences	ESC	3	0	2	5	4
6.	24BM2101	Biosciences for Medical Engineering	PCC	3	0	2	5	4
7.	24GE2103	Tamils and Technology தமிழரும் ததொழில்நுட்பமும்	HSMC	1	0	0	1	1
8.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
			Total	**18**	**1**	**12**	**31**	**25**

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MU3103	Random Processes and Linear Algebra	BSC	3	1	0	4	4
2.	24BM3101	Anatomy and Human Physiology	PCC	3	0	0	3	3
3.	24BM3102	Electric Circuit Analysis	PCC	3	0	2	5	4
4.	24EC3101	Data Structures and C++	ESC	3	0	2	5	4
5.	24EC3103	Electronic Devices and Circuits	PCC	3	0	0	3	3
6.	24BMPEXX	Professional Elective I	PEC	3	0	0	3	3
7.	24MC31XX	Mandatory Course I	MC	1	0	0	1	0
8.	24EC3201	Electronic Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
9.	24BM3201	Anatomy and Human Physiology Laboratory	PCC	0	0	3	3	1.5
			Total	**19**	**1**	**10**	**30**	**24**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BM4101	Biosensors and Measurements	PCC	3	0	0	3	3
2.	24BM4102	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
3.	24BM4103	Signal and Signal Processing	PCC	3	0	2	5	4
4.	24BM4104	Bio Control Systems	PCC	3	0	2	5	4
5.	24BMPEXX	Professional Elective II	PEC	3	0	0	3	3
6.	24CY4101	Environmental Science and Engineering	BSC	2	0	0	2	2
7.	24BM4201	Sensors and Measurements Laboratory	PCC	0	0	3	3	1.5
8.	24BM4202	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
9.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
			Total	**17**	**0**	**12**	**29**	**23**

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SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BM5101	Biomedical Instrumentation	PCC	3	0	0	3	3
2.	24EC5104	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
3.	24BM5102	Biomaterials	PCC	3	0	2	5	4
4.	24BM5103	Medical Image Processing	PCC	3	0	2	5	4
5.	24BMPEXX	Professional Elective III	PEC	3	0	0	0	3
6.	24BMPEXX	Professional Elective IV	PEC	3	0	0	3	3
7.	24MC51XX	Mandatory Course II	MC	1	0	0	1	0
8.	24BM5201	Biomedical Instrumentation Laboratory	PCC	0	0	3	3	1.5
9.	24EC5202	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	3	1.5
			Total	**19**	**0**	**10**	**26**	**23**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BM6101	Diagnostic and Therapeutic Equipment	PCC	3	0	0	3	3
2.	24BM6102	Artificial Intelligence and Machine Learning in Biomedicine	PCC	3	0	0	3	3
3.	24BMPEXX	Professional Elective V	PEC	3	0	0	3	3
4.	24BMPEXX	Professional Elective VI	PEC	3	0	0	3	3
5.	24BMPEXX	Professional Elective VII	PEC	3	0	2	5	4
6.	24OXXXXX	Open Elective I	OEC	3	0	2	5	4
7.	24BM6201	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	3	3	1.5
8.	24BM6202	Artificial Intelligence and Machine Learning Laboratory	PCC	0	0	3	3	1.5
9.	24PD6201	NCC/NSS/NSO*#	-	2	0	0	0	2*#
			Total	**18**	**0**	**10**	**28**	**23**

***# Guidelines for evaluation is provided in detail in the regulations/syllabus. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS7101	Professional Ethics in Engineering	HSMC	3	0	0	3	2
2.	24BM7101	Embedded Systems and IOMT	PCC	3	0	2	5	4
3.	24BMPEXX	Professional Elective VIII	PEC	3	0	2	5	4
4.	24OXXXXX	Open elective II	OEC	3	0	0	3	3
5.	24OXXXXX	Open elective-III	OEC	3	0	0	3	3
6.	24BM7501	Mini Project	EEC	0	0	4	4	2
7.	24IS7201	Internship[##]	EEC	-	-	-	-	1
8.	24CA7201	Case Study***	EEC	-	-	-	-	1
			Total	**15**	**0**	**8**	**23**	**20**

[##] Students should undergo Internship for a period of 2- 4 weeks during 6th Semester vacation.

***** Students should perform Case study during 6th Semester vacation.**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BM8501	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

BASIC SCIENCE COURSES (BSC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
2.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
3.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
4.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
5.	24PH2101	Material Science	BSC	3	0	0	3	3
4.	24MU3103	Random Processes and Linear Algebra	BSC	3	1	0	4	4
2.	24CY4101	Environmental Science and Engineering	BSC	2	0	0	2	2
							Total	**25**

ENGINEERING SCIENCE COURSES (ESC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
2.	24GE1201	Professional Development	ESC	0	0	4	4	2
3.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
4.	24GE2102	Fundamentals of Building and Mechanical Sciences	ESC	3	0	2	5	4
5.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
6.	24EC3101	Data Structures and C ++	ESC	3	0	2	5	4
							Total	**20**

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS1101	Professional English	HSMC	3	0	2	5	4
2.	24GE1102	Heritage of Tamils தமிழர் மரபு	HSMC	1	0	0	1	1
3.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
4.	24GE2103	Tamils and Technology தமிழரும் ததொழில்நுட்பமும்	HSMC	1	0	0	1	1
5.	24HS7101	Professional Ethics in Engineering	HSMC	3	0	0	3	2
							Total	**11**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
2.	24BM7501	Mini Project	EEC	0	0	4	4	2
3.	24IS7201	Internship	EEC	-	-	-	-	1
4.	24CA7201	Case Study	EEC	-	-	-	-	1
5.	24BM8501	Project Work	EEC	0	0	20	20	10
							Total	**15**

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BM2101	Biosciences for Medical Engineering	PCC	3	0	2	5	4
2.	24BM3101	Anatomy and Human Physiology	PCC	3	0	0	3	3
3.	24BM3102	Electric Circuit Analysis	PCC	3	0	2	5	4
4.	24EC3103	Electronic Devices and Circuits	PCC	3	0	0	3	3
5.	24EC3201	Electronic Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
6.	24BM3201	Anatomy and Human Physiology Laboratory	PCC	0	0	3	3	1.5
7.	24BM4101	Biosensors and Measurements	PCC	3	0	0	3	3
8.	24BM4102	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
9.	24BM4103	Signal and Signal Processing	PCC	3	0	2	5	4
10.	24BM4104	Bio Control Systems	PCC	3	0	2	5	4
11.	24BM4201	Sensors and Measurements Laboratory	PCC	0	0	3	3	1.5
12.	24BM4202	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
13.	24BM5101	Biomedical Instrumentation	PCC	3	0	0	3	3
14.	24EC5104	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
15.	24BM5102	Biomaterials	PCC	3	0	2	5	4
16.	24BM5103	Medical Image Processing	PCC	3	0	2	5	4
17.	24BM5201	Biomedical Instrumentation Laboratory	PCC	0	0	3	3	1.5
18.	24EC5202	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	3	1.5

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19.	24BM6101	Diagnostic and Therapeutic Equipment	PCC	3	0	0	3	3
20.	24BM6102	Artificial Intelligence and Machine Learning in Biomedicine	PCC	3	0	0	3	3
21.	24BM6201	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	3	3	1.5
22.	24BM6202	Artificial Intelligence and Machine Learning Laboratory	PCC	0	0	3	3	1.5
23.	24BM7101	Embedded Systems and IOMT	PCC	3	0	2	5	4
							Total	**64**

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER III & IV, PROFESSIONAL ELECTIVE I & II

BIOENGINEERING

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BMPE01	Medical Optics	PEC	3	0	0	3	3
2.	24BMPE02	Lasers in medicine	PEC	3	0	0	3	3
3.	24BMPE03	Genetic Engineering	PEC	3	0	0	3	3
4.	24BMPE04	Tissue Engineering	PEC	3	0	0	3	3
5.	24BMPE05	Biometric System	PEC	3	0	0	3	3
6.	24BMPE06	Forensic Science in Healthcare	PEC	3	0	0	3	3
7.	24BMPE07	Healthcare Analytics	PEC	3	0	0	3	3
8.	24BMPE08	Virtual Reality and Augmented Reality in Healthcare	PEC	3	0	0	3	3

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SEMESTER V, PROFESSIONAL ELECTIVE III & IV
COMMUNICATION AND HEALTHCARE DEVICES

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BMPE09	Biotelemetry	PEC	3	0	0	3	3
2.	24BMPE10	Body Area Networks	PEC	3	0	0	3	3
3.	24BMPE11	Communication Systems	PEC	3	0	0	3	3
4.	24BMPE12	Wearable Devices	PEC	3	0	0	3	3
5.	24BMPE13	Assistive Technology	PEC	3	0	0	3	3
6.	24BMPE14	Artificial Organs and Implants	PEC	3	0	0	3	3
7.	24BMPE15	Critical Care Equipment	PEC	3	0	0	3	3
8.	24BMPE16	Principles of Radiological Equipment	PEC	3	0	0	3	3

SEMESTER VI, PROFESSIONAL ELECTIVE V & VI
MEDICAL DEVICE INNOVATION AND MANAGEMENT

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BMPE17	Rehabilitation Engineering	PEC	3	0	0	3	3
2.	24BMPE18	Human Assist Devices	PEC	3	0	0	3	3
3.	24BMPE19	Patient Safety, Standards and Ethics	PEC	3	0	0	3	3
4.	24BMPE20	Ergonomics	PEC	3	0	0	3	3
5.	24BMPE21	Hospital Planning and Management	PEC	3	0	0	3	3
6.	24BMPE22	Medical Waste Management	PEC	3	0	0	3	3
7.	24BMPE23	Medical Innovation and Entrepreneurship	PEC	3	0	0	3	3
8.	24BMPE24	Bio MEMS	PEC	3	0	0	3	3

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SEMESTER VI & VII, PROFESSIONAL ELECTIVE VII & VIII
ADVANCED HEALTHCARE SYSTEM AND DESIGN

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24BMPE25	Speech and Audio Signal Processing	PEC	3	0	2	5	4
2.	24BMPE26	Medical Device Design	PEC	3	0	2	5	4
3.	24BMPE27	Telehealth Technology	PEC	3	0	2	5	4
4.	24BMPE28	Clinical Engineering	PEC	3	0	2	5	4
5.	24BMPE29	Advancements in Healthcare Technology	PEC	3	0	2	5	4
6.	24BMPE30	Medical Informatics and Expert Systems	PEC	3	0	2	5	4
7.	24BMPE31	Internet of Things	PEC	3	0	2	5	4
8.	24BMPE32	Biomechanics	PEC	3	0	2	5	4

MANDATORY COURSES (MC)

MANDATORY COURSES I

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MC3101	Legal System of India	MC	3	0	0	3	0
2.	24MC3102	IPR and Patent Drafting	MC	3	0	0	3	0
3.	24MC3103	Literary Forms and Techniques	MC	3	0	0	3	0
4.	24MC3104	Disaster Risk Reduction and Management	MC	3	0	0	3	0
5.	24MC3105	Film Appreciation	MC	3	0	0	3	0
6.	24MC3106	Women and Gender Studies	MC	3	0	0	3	0

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MANDATORY COURSES II

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MC5101	Food and Nutrition	MC	3	0	0	3	0
2.	24MC5102	Design Thinking	MC	3	0	0	3	0
3.	24MC5103	History of Science and Technology in India	MC	3	0	0	3	0
4.	24MC5104	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
5.	24MC5105	State, Nation Building and Politics in India	MC	3	0	0	3	0
6.	24MC5106	Industrial Safety	MC	3	0	0	3	0

OPEN ELECTIVE COURSES (OEC)

OPEN ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCI101	Estimation and Costing of Building	OEC	3	0	2	5	4
2.	24OCI102	Quality Assessment of Building Materials	OEC	3	0	2	5	4
3.	24OCI103	Project Management	OEC	3	0	2	5	4
4.	24OCI104	Building Planning using Vaastu Sastra	OEC	3	0	2	5	4
5.	24OAI101	Web Technology	OEC	3	0	2	5	4
6.	24OAI102	Object Oriented Programming	OEC	3	0	2	5	4
7.	24OAI103	Computational Data Analytics	OEC	3	0	2	5	4
8.	24OAI104	Networking Concepts	OEC	3	0	2	5	4
9.	24OEI101	Control System Engineering	OEC	3	0	2	5	4
10.	24OEI102	Power Electronics and Drives	OEC	3	0	2	5	4
11.	24OEI103	PLC Programming	OEC	3	0	2	5	4
12.	24OEI104	Electronic Devices and Power Amplifiers	OEC	3	0	2	5	4

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13.	24OMI101	Internal Combustion Engines	OEC	3	0	2	5	4
14.	24OMI102	Testing of Engineering Materials	OEC	3	0	2	5	4
15.	24OMI103	Industrial Layout Design and Safety	OEC	3	0	2	5	4
16.	24OMI104	Product Design and Process Development	OEC	3	0	2	5	4

OPEN ELECTIVE II & III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCT201	Building Planning and Approval	OEC	3	0	0	3	3
2.	24OCT202	Energy Efficient Building	OEC	3	0	0	3	3
3.	24OCT203	Environmental Impact Assessment	OEC	3	0	0	3	3
4.	24OCT204	Rehabilitation of Structures	OEC	3	0	0	3	3
5.	24OCT205	Drinking water supply and Treatment	OEC	3	0	0	3	3
6.	24OCT206	Project Scheduling and Optimization using CPM and PERT Techniques	OEC	3	0	0	3	3
7.	24OAT201	Principles of Programming Languages	OEC	3	0	0	3	3
8.	24OAT202	Information Security Management	OEC	3	0	0	3	3
9.	24OAT203	Human Computer Interaction	OEC	3	0	0	3	3
10.	24OAT204	Computer Application in Agricultures	OEC	3	0	0	3	3
11.	24OAT205	Mobile Computing	OEC	3	0	0	3	3
12.	24OAT206	Object Oriented Analysis and Design	OEC	3	0	0	3	3
13.	24OET101	Electric Vehicle Technologies	OEC	3	0	0	3	3
14.	24OET102	Power System	OEC	3	0	0	3	3
15.	24OET103	Circuit Theory	OEC	3	0	0	3	3
16.	24OET104	Advanced Electrical Machines	OEC	3	0	0	3	3

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17.	24OET105	Hybrid Renewable Power Generation	OEC	3	0	0	3	3
18.	24OET106	Electrical Maintenance and Safety	OEC	3	0	0	3	3
19.	24OMT201	Bioenergy Conversion Technologies	OEC	3	0	0	3	3
20.	24OMT202	Automotive Materials, Components, Design and Testing	OEC	3	0	0	3	3
21.	24OMT203	Green Manufacturing Design and Practices	OEC	3	0	0	3	3
22.	24OMT204	Semiconductor Manufacturing	OEC	3	0	0	3	3
23.	24OMT205	Future Energy Resources and Mobility	OEC	3	0	0	3	3
24.	24OMT206	Failure Analysis and NDT Techniques	OEC	3	0	0	3	3

SUMMARY

S. No.	Subject Area	Credits Per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1.	Basic Science Course (BSC)	12	7	4	2	-	-	-	-	**25**
2.	Professional Core Courses (PCC)	-	4	13	17	17	9	4	-	**64**
3.	Professional Elective Courses (PEC)	-	-	3	3	6	10	4	-	**26**
4.	Open Elective Courses (OEC)	-	-	-	-	-	4	6	-	**10**
5.	Employability Enhancement Courses (EEC)	-	-	-	1	-	-	4	10	**15**
6.	Engineering Science Courses (ESC)	6	10	4	-	-	-	-	-	**20**
7	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	**0**
8	Humanities, Social Sciences and Management Courses (HSMC)	5	4	-	-	-	-	2	-	**11**
	Total Credit	**23**	**25**	**24**	**23**	**23**	**23**	**20**	**10**	**171**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 171

24HS1101 PROFESSIONAL ENGLISH **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To enable the students to learn the fundamentals of English grammar.
- To develop the ability to write complex texts and essays that are relevant to authentic contexts.
- To present their opinions through letters and reports that will be relevant for their future endeavours.

UNIT I FUNDAMENTALS & SUMMATION **9**

Grammar & Vocabulary: Parts of Speech, Articles, Pronoun, Homonyms & Homophones, Word Formation (Prefix and Suffix). **Listening:** Telephonic Conversations - different viewpoints on a topic. **Speaking:** Self-Introduction Conversation - politeness strategies; asking for information to fill details in a form **Reading:** Reading biographies, travelogues, newspaper reports. **Writing**: Report writing (Accident report, Survey Report), Checklist.

UNIT II PROBLEM SOLVING & RECOMMENDATIONS **9**

Grammar & Vocabulary: Abbreviations & Acronyms, Tenses, Subject -Verb Agreement, Active, Passive and Impersonal Passive Voice. **Listening:** Listening to anecdotes, stories & event narration. **Speaking:** Narrating personal experiences/ events, Extempore, Story-Telling. **Reading:** Reading Editorials; and Opinion Blogs. **Writing**: Letter Writing (Complaint Letter, Response to complaint), Recommendations.

UNIT III DESCRIPTION OF A PROCESS OR PRODUCT AND USAGE OF IMPERATIVE **9**

Grammar & Vocabulary: Adjective, Degrees of Comparison, Imperative and Gerund, One Word Substitution. **Listening:** Classroom Lecture, advertisements about products. **Speaking –** Picture description; giving instruction to use the product; presenting a product. **Reading:** Reading advertisements, gadget reviews; user manuals. **Writing**: Instructions, Process and Product Description.

UNIT IV DRAFTING AND RESUME MAKING **9**

Grammar & Vocabulary: Collocations, Conjunction, Framing Question Tags/ "Wh" questions. **Listening:** TED talks, educational videos. **Speaking –** Small Talk; Mini presentations and making recommendations. **Reading**: Reading brochures (technical context). **Writing:** Email writing and Email etiquette- Job Application Letter and Resume.

UNIT V EXPRESSING IDEAS **9**

Grammar & Vocabulary: Discourse Markers, Cause and Effect words, Modal verbs, Spotting Errors. **Listening:** Panel Discussions, listening to debates. **Speaking:** Group discussions, Debates and Expressing opinions & Role play. **Reading:** Reading Newspaper articles; Journal reports. **Writing:** Essay writing (Narrative, Descriptive), Reading Comprehension, Transcoding (Bar chart, Pie chart, Table).

TOTAL: 45 PERIODS

LIST OF ACTIVITIES

1. Self-Introduction-Politeness Strategies.
2. Extempore.
3. Story Telling.
4. Picture Description.
5. Product Description.
6. Presentations.
7. Group Discussion.
8. Role-Play.
9. Debates and Expressing Opinions.
10. Narrating Personal Experiences.
11. Reading Biographies, Travelogues.
12. Reading Advertisements, User Manuals.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Acquire knowledge on the basic grammatical structures and use them in right context.

CO2: Write complaint letters and recommendations with utmost accuracy.

CO3: Describe about products and processes clearly.

CO4: Write a job application letter and resume without flaws.

CO5: Speak fluently and interpret information presented in tables, charts and other graphic forms.

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TEXT BOOKS

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. Dr S Gunasekaran, "A Workbook of Professional English", Vishnu Prints Media, 2021.
3. Meenakshi Raman & Sangeeta Sharma, "Technical Communication – Principles and Practices", Oxford Univ. Press, 2022.

REFERENCE BOOKS

1. Raymond Murphy, "Essential English Grammar", 2nd Edition, Cambridge University Press, 2024.
2. Brain Chanen, "IB English A: Language and Literature", Oxford Publications, 2019.
3. Phil Williams, "Advanced Writing Skills for Students of English", Goodwill Publishing House, 2022.
4. Stella Cortrell, "The Study Skills Handbook", Red Globe Press, 2019.
5. Adrian Wall, "English for Academic Correspondence and Socializing", Springer Publications, 2017.

Mapping of COs with POs and PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24MU1101 MATRICES AND CALCULUS **L T P C**

3 1 0 4

COURSE OBJECTIVES

- To familiarize the students with Eigen values and Eigen vectors to reduce the quadratic form to canonical form.
- To familiarize the students with differential calculus and functions of several variables.
- To make the students to solve the problems on integration and multiple integration.

UNIT I MATRICES **9+3**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem (without proof) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **9+3**

Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

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

Partial differentiation – Homogeneous functions and Euler's theorem (without proof) – Jacobians – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **9+3**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Apply matrix algebra methods for solving various application problems.

CO2: Apply differential calculus methods in solving various application problems.

CO3: Apply the differential calculus ideas on several variable functions.

CO4: Apply different methods of integration in solving practical problems.

CO5: Apply multiple integral methods in solving areas, volumes and other practical problems.

TEXT BOOKS

1. T. Veerarajan, "Engineering Mathematics (Volume I & II)", McGraw Hill Education, New Delhi, 2018.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, 2024.
3. Erwin Kreyszig, "Advanced_Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015.

REFERENCE BOOKS

1. B.V .Ramana, "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2. John Bird, "Bird's Higher Engineering Mathematics", 9th Edition, Routledge Taylor and Fransis Group, 2021.
3. H.Anton, I.Bivens. I and S. Davis, "Calculus ", Wiley, 10th Edition, 2016.
4. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
5. G.B.Thomas, J.Hass and M.D.Weir, "Thomas Calculus ", 14th Edition, Pearson India, 2018.

Mapping of COs with POs and PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	2	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24PH1101 ENGINEERING PHYSICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To make the students to understand the properties of matter.
- To analysis the ultrasonic wave and laser with applications.
- To get knowledge on optical fibers and the importance of quantum theory.

UNIT I PROPERTIES OF MATTER **9**

Introduction – Elasticity – Hooke's Law – Stress –strain diagram – Types of modulus of elasticity –bending of beams – bending moment – cantilever : theory and experiment – uniform and non-uniform bending: theory and experiment – twisting couple – torsion pendulum: theory and experiment – I – shaped girders.

UNIT II ULTRASONICS AND BIO MEDICAL APPLICATIONS **9**

Introduction – Production of ultrasonics: magnetostriction effect and piezo electric effect – Velocity measurement: acoustic grating – Industrial applications: drilling, welding, soldering and cleaning –SONAR – Non Destructive testing – pulse echo system through transmission and reflection modes- A, B and C – scan displays, Clinical Applications -Sonograms.

UNIT III LASERS **9**

Introduction – Einstein's theory – Population inversion, pumping – Types of lasers; Nd-YAG Laser, He-Ne Laser,Semiconductor lasers (homo junction & hetero junction) – Industrial Applications-Lasers in welding, heat treatment, cutting.

UNIT IV FIBER OPTICS **9**

Principle and propagation of light in optical fibres – Acceptance angle and Numerical aperture-Types of optical fibres (material, refractive index, mode) – Optical Loss in optical fibre – attenuation, dispersion, bending – Fibre optical communication system (Block diagram) – Endoscope.

UNIT V QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect – Theory and experimental verification – Matter waves – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function–Transmission Electron microscope –Scanning electron microscope.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of unknown mass of a body for known rigidity modulus – Torsion pendulum.
3. Determination of Young's modulus by non – uniform bending method.
4. Determination of unknown mass of a body for known Young's modulus by non – uniform bending method.
5. Determination of Young's modulus by uniform bending method.

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6. Determination of unknown mass of a body for known Young's modulus by uniform bending method.
7. Determination of wavelength of Laser by diffraction grating method.
8. Determination of thickness of material using Air wedge.
9. Determination of width of the groove in a CD using Laser Diffraction.
10. Determination of Compressibility of given liquid using Ultrasonic interferometer.
11. Simple harmonic oscillations of cantilever.
12. Determination of unknown mass of a body for known Young's modulus by cantilever simple harmonic oscillations.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Gain knowledge on basics of properties of matter.

CO2: Acquire knowledge on magnetic ultrasonic waves and its applications.

CO3: Demonstrate the strong fundamental knowledge in Laser.

CO4: Acquire knowledge on function of fiber optical devices and its applications.

CO5: Explain the concepts of quantum physics.

TEXT BOOKS

1. Bhattacharya D K & Poonam T, "Engineering Physics", Oxford University Press, 2015.
2. Gaur R K & Gupta S L, "Engineering Physics", Dhanpat Rai Publishers, 2018.
3. Arthur Beiser, Shobhit Mahajan Sand Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCE BOOKS

1. Serway R A & Jewett J W, "Physics for Scientists and Engineers", Cengage Learning, 2016.
2. Tipler P A & Mosca G, "Physics for Scientists and Engineers with Modern Physics", W.H.Freeman, 2017.
3. K Thyagarajan & A Ghatak, "Lasers: Fundamentals and Applications", Laxmi Publications, (Indian Edition), 2019.
4. D. Halliday, R. Resnick and J Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5. Pandey B K & Chaturvedi S "Engineering Physics", Cengage Learning India, 2012.

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Mapping of COs with POs and PSOs

Cos	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	3	-	-	-	-	-	-	-	3	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	-
AVG	**3**	**2**	**2.8**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.6**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24CY1101 ENGINEERING CHEMISTRY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To familiarize students about the treatment of boiler feed water.
- To gain the knowledge about the various types of batteries and fuels.
- To understand the properties of Engineering materials and Nanomaterials.

UNIT I WATER TECHNOLOGY **9**

Hardness of water - Types - Boiler troubles - Scale - Sludge - Caustic embrittlement - Priming and Foaming - Softening of boiler feed water - Internal conditioning (phosphate, calgon and carbonate conditioning) - External conditioning - Ion Exchange process - Zeolite process.

UNIT II ENERGY STORAGE **9**

Batteries - Types of batteries - Primary battery - Dry cell, Secondary battery - Lead acid battery and Lithium- ion-battery - Fuel cells - H_2-O_2 fuel cell- E-Vehicles - Advantages of E-Vehicles.

UNIT III ENGINEERING MATERIALS **9**

Refractories - classification - properties and applications of refractories - Abrasives - properties and Applications of abrasives - Cement - composition of cement - setting and hardening of cement - Glass - Manufacture - Types of glass and its uses.

UNIT IV NANOCHEMISTRY **9**

Nanomaterials - Distinction between Nanoparticles, Molecules and Bulk materials - Types of Nanomaterials - Nanoparticle - Nanowire and Nanotube - Preparation of Nanomaterials - sol-gel- solvothermal Methods and Applications of Nanomaterials in Agriculture and Medicine field.

UNIT V FUELS **9**

Fuels - Coal - Analysis of coal (Proximate Analysis)-Refining of Petroleum - Fractional Distillation - Manufacture of metallurgical coke (Otto Hoffmann method) - Manufacture of synthetic petrol (Bergius process) - Power alcohol – Biodiesel.

TOTAL:45 PERIODS

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LIST OF EXPERIMENTS

1. Estimation of total, temporary and permanent Hardness of the sample water by EDTA method.
2. Estimation of strength of given Hydrochloric acid using pH meter.
3. Estimation of strength of given Hydrochloric acid using conductivity meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of amount of $BaCl_2$ present in the given solution using Std.Na_2SO_4 using conductivity meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Estimation of amount of Cl^- ion present in the given solution by Argentometric method.
8. Determination of alkalinity of the water sample using HCl with Na_2CO_3 as the primary standard.
9. Prepare Na_2CO_3 as primary standard and using it to estimate the acidity present in the given water sample.
10. Estimation of copper content of the given solution by EDTA method.
11. Determination of Dissolved oxygen content of water sample by Winkler's method.
12. Preparation of Biodiesel by using vegetable oil.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Assess water impurities, determining hardness and eliminating substances responsible for hardness.

CO2: Identify diverse energy resources and effectively apply them in various sectors of the energy industry.

CO3: Assess engineering materials that meet industry specifications and requirements.

CO4: Identify and apply basic concepts of Nano science and technology in designing the synthesis of Nanomaterials for Engineering and Technology.

CO5: Recommend suitable fuels for engineering processes and applications.

TEXT BOOKS

1. P C Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company(P) Ltd, New Delhi , 17th Edition, 2022.
2. Friedrich Emich, "Engineering Chemistry", Scientific International Pvt. Ltd., New Delhi, 2017.
3. S S Dara, "A text book of Engineering Chemistry", S Chand Publishing, 12th Edition, 2018.

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REFERENCE BOOKS

1. Hammer Sr and Hammer Jr, "Water and waste water technology", Pearson Education India, 7th Edition, 2015.
2. Nihal Kularatna and Kosala Gunawardane, "Energy Storage Devices for Renewable Energy-based Systems", Academic Pr, 2nd Edition, 2021.
3. Kenneth G Budinski, Michael K Budinski, "Engineering Materials", Pearson, 9th Edition, 2016.
4. Chattopadhyay K K, "Introduction to Nanoscience and Nanotechnology", Prentice Hall India Learning Private Limited, 2021.
5. James G Speight, "Handbook of Natural Gas Analysis", Wiley, 1st Edition, 2018.

Mapping of COs with POs and PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO2	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO5	2	2	2	2	-	2	-	-	-	-	-	2	2	-
AVG	2	2	2	2	-	2	-	-	-	-	-	2	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE1101 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

Fundamentals of Computing – Identification of Computational Problems – Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guessan integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

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UNIT III CONTROL FLOW, FUNCTIONS, STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if – else), chained conditional (if el if – else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter‘s age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

LIST OF PROGRAMS

1. Calculate the GCD of two numbers.
2. Find the square root of an integer using Newton‘s method.
3. Find power of a number using Exponential operator.
4. Find the maximum of a list of numbers.
5. Develop a program to search the given numbers using linear search and binary search.
6. Develop a program that sorts a list by implementing selection sort, insertion sort.
7. Develop a program that sorts a list by implementing mergesort.
8. Program to print n prime numbers.
9. Find multiplication of two matrix.
10. Programs that take command line arguments (word count).
11. Find the most frequent words in a text read from a file.
12. Simulate elliptical orbits and bouncing ball using Py game.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Write simple Python programs using conditionals, loops and functions for solving problems.

CO3: Decompose a Python program into functions.

CO4: Represent compound data using Python lists, tuples, and dictionary e set c.

CO5: Read and write data from / to files in Python programs.

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TEXT BOOKS

1. Allen B Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Eric Matthes, "Python Crash Course: Python for beginners", 3rd Edition, No Strach Press Limited, 2024.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, ""Python for Programmers, Pearson Education", 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C Brown, " Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	3	-	-	-	-	-	-	-	-	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	-	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	-	2
AVG	**3**	**3**	**3**	**2**	**3**	-	-	-	-	-	-	-	-	**2**

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE1101 தமிழர் மரபு **L T P C**
1 0 0 1

பாடத்தின் நோக்கங்கள்

- மாணவர்கள் மொழி மற்றும் இலக்கியம் பற்றி கற்றறிதல்.
- தமிழர்களின் பாரம்பரிய மரபு மற்றும் நாட்டுப்புறக் கலைகளை அறிந்து கொள்ளுதல்.
- தமிழர்களின் திணைக்கோட்பாடுகள் மற்றும் இந்தியப் பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி அறிந்து கொள்ளுதல்.

அலகு I – மொழி மற்றும் இலக்கியம்

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 வரலாற்றில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II – மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – கதர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III – நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

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

அலகு IV – தமிழர்களின் திணைக்கோட்பாடு

தமிழகத்தின் தாவரங்களும் விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்க கால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V – இந்திய தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிற பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த

மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

பாடநெறி முடிவுகள்

பாடத்திட்டத்தை முடித்த பிறகு, மாணவர்கள் செய்யக் கூடியவை:

CO1: செம்மொழி மற்றும் சமகால படைப்புகளில் கவனம் செலுத்தி, மொழிப்புலமை மற்றும் இலக்கியப் பகுப்பாய்வின் முக்கியத்துவத்தைக் கற்றறிந்தனர்.

CO2: தமிழ் இலக்கியத்தின் பாரம்பரிய மரபுக் கலைகளை மாணவர்கள் அறிந்து கொண்டனர்.

CO3: சங்ககால இலக்கியங்களையும் இக்கால இலக்கியக் கவிஞர்களின் தமிழையும் மாணவர்கள் அறிந்து கொண்டனர்.

CO4: தமிழ் இலக்கியத்தின் கலாச்சார மற்றும் சமூக தாக்கங்களை அறிந்து கொண்டனர்.

CO5: பண்டைக்கால மக்களின் தமிழ் அடையாளம் மற்றும் கலாச்சார பாரம்பரியத்தைப் பற்றி கற்றறிந்தனர்.

பாடப் புத்தகங்கள்

1. கே. கே. பிள்ளை, "தமிழக வரலாறு – மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம், 2004.
2. முனைவர் இல. சுந்தரம், "கணினித் தமிழ்", விகடன் பிரசுரம், 2015.
3. டாக்டர் எஸ். வி. சுப்ரமணியன், டாக்டர் கே. டி. திருநாவுக்கரசு, "தமிழர்களின் வரலாற்றுப் பாரம்பரியம்", சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர் சிங்காரவேலு, "தமிழர்களின் சமூக வாழ்க்கை", சர்வதேச தமிழாய்வு நிறுவனம்.
2. கீழடி "வைகை ஆற்றின் கரையில் உள்ள சங்க நகர நாகரிகம்", தொல்லியல் துறை, தமிழ்நாடு பாடநூல் மற்றும் கல்விச் சேவைகள் கழகம், தமிழ்நாடு, 2015.
3. டாக்டர் கே. கே. பிள்ளை, "இந்திய வரலாறு", வெளியீடு ஆசிரியர்.
4. "பொருநை நாகரிகம்", தொல்லியல்துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்விச் சேவைகள் கழகம்.
5. ஆர். பாலகிருஷ்ணன், "வைகை, சிந்து நாகரிகத்தின் பயணம்", வெளியீடு – EMRL.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	-	-
AVG	-	-	-	-	-	**2**	-	**2**	-	-	-	-	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE1201 PROFESSIONAL DEVELOPMENT **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWER POINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.

MS WORD **15**

- Create and format a document.
- Working with tables.
- Working with Bullets and Lists.
- Working with styles, shapes, smart art, charts.
- Inserting objects, charts and importing objects from other office tools.
- Creating and Using document templates.
- Inserting equations, symbols and special characters.
- Working with Table of contents and References, citations.
- Insert and review comments.
- Create bookmarks, hyperlinks, endnotes footnote.
- Viewing document in different modes.
- Working with document protection and security.
- Inspect document for accessibility.

MS EXCEL **15**

- Create worksheets, insert and format data.
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data.
- Sort and filter data.
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,).
- Work with Lookup and reference formulae.
- Create and Work with different types of charts.

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- Use pivot tables to summarize and analysis data.
- Perform data analysis using own formulae and functions.
- Combine data from multiple worksheets using own formulae and built-in functions to generate results.
- Export data and sheets to other file formats.
- Working with macros.
- Protecting data and Securing the workbook.

MS POWERPOINT **15**

- Select slide templates, layout and themes.
- Formatting slide content and using bullets and numbering.
- -Insert and format images, smart art, tables, charts.
- Using Slide master, notes and handout master.
- Working with animation and transitions.
- Organize and Group slides.
- Import or create and use media objects: audio, video, animation.
- Perform slideshow recording and Record narration and create presentable videos.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Use MS Word to create quality documents, by structuring and organizing content.

CO2: Use MS Word for their day to day technical and academic requirements.

CO3: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements.

CO4: Use MS EXCEL to visualize data for ease of understanding.

CO5: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24HS2101 WRITING SKILLS FOR PROFESSIONALS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To use appropriate language structures to write letters.
- To write reports and emails with ease.
- To think critically and write different types of essays.

UNIT I SELF EXPRESSION **9**

Grammar: Punctuation-Direct and Indirect Questions - Adverbs- Prepositions. **Vocabulary:** Commonly confused words. **Writing:** Extended Definitions- Letter to the Editor.

UNIT II FORMAL EXPRESSION **9**

Grammar: Phrasal Verbs, Adverbs, Simple, Compound and Complex Sentences. **Vocabulary:** Synonyms & Antonyms. **Writing:** Email Writing (formal & informal) –Report Writing (Industrial Visit & Field Visit).

UNIT III CREATIVE EXPRESSION **9**

Grammar: Prepositional Phrases, Numerical Adjectives, Compound Nouns. **Vocabulary:** British and American words. **Writing:** Compare and Contrast Essay, SOP.

UNIT IV EXPRESSION OF IDEAS **9**

Grammar: Direct and Indirect Speech, Relative Pronoun. **Vocabulary:** Idioms & phrases. **Writing:** Asking for information and making suggestions- Report Writing on College Event.

UNIT V PROFESSIONAL EXPRESSIONS **9**

Grammar: Fixed and Semi- fixed - Content vs Function words. **Vocabulary:** Jumbled Sentences. **Writing:** Accepting/ Declining an Offer/ invitation-Note- Making, Argumentative Essay.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Enhance their grammatical competency for flawless writing.
CO2: Write reports, emails meeting professional expectations.
CO3: Use grammar to form correct sentences with maximum accuracy.
CO4: Present their ideas and opinions in a planned and logical manner.
CO5: Write essays on various topics.

TEXT BOOKS

1. English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. English for Science & Technology Cambridge University Press, 2021.
3. Communication Skills for Professionals, Nira Konar Second Edition, PHI Learning Pvt. Ltd, 2021.

REFERENCE BOOKS

1. William Zinsser Paperback, “On Writing Well”, Harper Perennial Publishers, 2016.
2. D S Paul, “Advanced Writing Skills”, Good will Publishing House, 2022.
3. Matthew T Zakaria, “Successful Writing Skills”, Commonwealth Publishers, 2022.
4. G S Hook, “Effective Communication” (Updated version 2nd edition), Sannainvest Ltd., 2021.
5. Alan Baker, “Improve Your Communication Skills” (How to Build Trust, Be Heard and Communicate with Confidence), Kogan Page Publishers, 2019.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24MU2101 STATISTICS AND NUMERICAL METHODS **L T P C**

3 1 0 4

COURSE OBJECTIVES

- To understand the concept of Correlation, Regression, Testing of hypothesis and design of experiments.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand the concept of numerical methods for solving differentiation and integration equations.

UNIT I CORRELATION AND REGRESSION **9+3**

Correlation – Coefficient of Correlation – Rank Correlation – Regression – Estimation of Regression lines.

UNIT II TESTING OF HYPOTHESIS & DESIGN OF EXPERIMENTS **9+3**

Sampling distributions – Small samples – t-test – Tests for single mean and difference of means – F-test – Tests for single variance and equality of variances – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3**

Solution of Algebraic and Transcendental equations – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Inverse of Matrix by Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power Method.

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

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

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UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order differential equations – Multi step methods: Milne's and Adam's – Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Apply the correlation and regression equations for engineering problems.

CO2: Apply the concept of testing of hypothesis for small samples in real life problems and classifications of design of experiments in the field of agriculture.

CO3: Apply the numerical methods to solve the algebraic, transcendental and linear system of equations.

CO4: Apply interpolation techniques and numerical methods to solve the derivatives and integrals.

CO5: Apply various numerical methods for solving ordinary differential equations.

TEXT BOOKS

1. Gupta S.C., and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Gupta S.P., "Statistical Method", Sultan Chand & Sons, New Delhi, 46th Edition, 2019.
3. Grewal B. S., and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCE BOOKS

1. Spiegel M.R., Schiller J., and Srinivasan R.A., "Schaum's easy Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2020.
2. Devore J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2020.
3. Johnson R. A., Miller I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, 9th Edition, 2020.
4. Burden R.L and Faires J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
5. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods", New International Publishers, 8th Edition, 2022.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24PH2101 MATERIAL SCIENCE **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the properties of conducting and semiconducting materials.
- To acquire knowledge on magnetic and dielectric materials with their applications.
- To get an idea of nano structures and basics of quantum computing.

UNIT I CONDUCTING MATERIALS **9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

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Since 1984

UNIT II SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – intrinsic carrier concentration derivation – Fermi level – electrical conductivity – band gap determination – derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC MATERIALS **9**

Origin of magnetic moment – Bohr magneton – properties of Dia, Para and Ferro magnetic materials – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites and its applications.

UNIT IV DIELECTRIC MATERIALS **9**

Electrical susceptibility – dielectric constant– electronic, ionic, orientational and space charge polarization–frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – ferro electricity and applications.

UNIT V NANO DEVICES AND QUANTUM COMPUTING **9**

Introduction – quantum confinement – quantum structures: quantum wells, wires and dots – Tunneling – Coulomb blockade – Single electron phenomena: single electron transistor – Quantum system for information processing – quantum states – classical bits – quantum bits – CNOT gate – advantage of quantum computing over classical computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Gain knowledge on electrical and thermal properties of conducting materials.

CO2: Get adequate knowledge on charge carrier's distribution in different types of semiconductors.

CO3: Get the necessary understanding of functioning of Magnetic materials.

CO4: Get the necessary understanding of functioning of dielectric materials.

CO5: Gain knowledge on new engineering materials and their preparation methods.

TEXT BOOKS

1. S.O. Kasap, "Principles of Electronic Materials and Devices", Mc-Graw Hill, 2018.
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", Mc-Graw Hill India, 2019.
3. Parag K. Lala, "Quantum Computing: A Beginner's Introduction", McGraw-Hill Education, Indian Edition, 2020.

REFERENCE BOOKS

1. R. Balasubramaniam, Callister's, "Materials Science and Engineering". Wiley Indian Edition, 2015.
2. Wendelin Wright and Donald Askeland, "Essentials of Materials Science and Engineering", CL Engineering, 2015.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley India Edition, 2019.
4. Mark Fox, "Optical Properties of Solids", Oxford Univ. Press, 2021.
5. B.Rogers, J.Adams and S.Pennathur, "Nanotechnology: Understanding Small Systems", CRC Press, 2017.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	2	-
AVG	3	2	2.8	2	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE2101 ENGINEERING GRAPHICS **L T P C**
2 0 4 4

COURSE OBJECTIVES

- Drawing engineering curves, freehand sketch of simple objects and orthographic projections.
- Drawing Projection, section and development of solids.
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING **6+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

Orthographic projection – principles – Principal planes – First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to one principal plane by rotating object method.

UNIT III PROJECTION OF SOLIDS **6+12**

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **6+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 90 PERIODS

COURSE OUTCOMES

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

CO1: Construct the conic curves, involutes and cycloid.

CO2: Solve practical problems involving projection of line and plane surfaces.

CO3: Depict the orthographic, isometric and perspective projections of simple solids

CO4: Explore the development of section of solids and development of surfaces.

CO5: Draw the isometric and perspective projections.

Publication of Bureau of Indian Standards

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

TEXT BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCE BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren J and Duff, John M, "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. Shah M B, and Rana B C, "Engineering Drawing", Pearson, 2nd Edition, 2009.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO2	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO3	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO4	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO5	2	3	3	2	-	-	-	-	2	2	-	-	2	-
AVG	2	3	3	2	-	-	-	-	2	2	-	-	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE2102 FUNDAMENTALS OF BUILDING AND MECHANICAL SCIENCES **L T P C 3 0 2 4**

COURSE OBJECTIVES

- To provide the basic knowledge, concepts and specialized sub-disciplines of Civil and Mechanical Engineering.
- To introduce fundamental principles of surveying, building materials, and construction techniques.
- To impart knowledge on power plants, internal combustion engines, refrigeration, and air conditioning systems.

UNIT I OVERVIEW OF CIVIL ENGINEERING **5**

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

OVERVIEW OF MECHANICAL ENGINEERING **4**

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

UNIT II SURVEYING AND CIVIL ENGINEERIN MATERIALS **9**

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only).

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE **9**

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS **9**

Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM **9**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

Basic Mechanical Laboratory **15**

1. Study of IC Engines, Components.
2. Study of Steam Generators and Turbines.
3. Valve Timing and Port Timing Diagrams.
4. Determination of Viscosity –Red Wood Viscometer.
5. Determination of Flash Point and Fire Point.
6. Izod Impact Test.
7. Rockwell Hardness Test.

Basic Civil Laboratory **15**

I. TESTS ON CEMENT

a. Determination of fineness of cement.
b. Determination of consistency of cement.
c. Determination of specific gravity of cement.
d. Determination of initial and final setting time of cement.

II. TESTS ON FINE AGGREGATE AND COURSE AGGREGATE

a. Determination of specific gravity and water absorption of fine aggregate.
b. Determination of grading of fine aggregate.
c. Determination of aggregate crushing value of coarse aggregate.
d. Determination of specific gravity and water absorption of coarse aggregate.

III. TESTS ON BRICKS

a. Determination of compressive strength of bricks.
b. Determination of water absorption of bricks.
c. Determination of efflorescence of bricks.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explore the role of Civil and Mechanical Engineering in societal development.
CO2: Recognize different types of building materials and their modern applications.
CO3: Comprehend the principles and methods used in surveying and leveling.
CO4: Explain the working principles of internal combustion engines and power plants.
CO5: Explore the refrigeration, air conditioning systems, and psychrometric processes.

TEXT BOOKS

1. Satheesh Gopi, “Basic Civil Engineering”, Pearson India, 2009.
2. Pravin Kumar, “Basic Mechanical Engineering”, Pearson Education India, 2013.
3. G Shanmugam and M S Palanichamy, “Basic Civil and Mechanical Engineering”, McGraw Hill Education; First edition, 2018.

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REFERENCE BOOKS

1. Palanikumar K, "Basic Mechanical Engineering", ARS Publications, 2018.
2. Ramamrutham S, "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2013.
3. Seetharaman S, "Basic Civil Engineering", Anuradha Agencies, 2005.
4. Shantha Kumar SRJ, "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
5. D Natarajan, "Basic Civil and Mechanical Engineering", Anuradha Publications, 2013.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	-	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM2101 BIOSCIENCES FOR MEDICAL ENGINEERING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To study structural and functional properties of carbohydrates, proteins, lipids and amino acids.
- To emphasize the role of biomolecules by providing basic information on specific metabolic diseases and disorders of biomolecules.
- Gain knowledge on the structural and functional aspects of living organism, aetiology and treating the pathological diseases.

UNIT I FUNDAMENTALS TO BIOCHEMISTRY **9**

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II CARBOHYDRATES, LIPIDS, PROTEIN **9**

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.

UNIT III CELL DEGENERATION, REPAIR AND NEOPLASIA **9**

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT IV FLUID AND HEMODYNAMIC DERANGEMENTS **9**

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders- Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT V FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY **9**

Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and virus - List of common bacterial, fungal and viral diseases of human beings. - Basics of Microscopes: Light microscope, Electron microscope (TEM & SEM). - Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury, Immunological techniques: immune diffusion, immune electrophoresis, RIA and ELISA, monoclonal antibodies.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions.
2. Standardization of pH meter, preparation of buffers, emulsions.
3. General tests for carbohydrates, proteins and lipids.
4. Identification of Blood Collection Tubes and Phlebotomy equipment.
5. Preparation of serum and plasma from blood.
6. Estimation of Hemoglobin.
7. Estimation of blood glucose.
8. Estimation of creatinine, urea and Uric acid.
9. Types of Staining: Simple stain, Gram stain, Hematoxylin and eosin staining.
10. Study of parts of compound microscope.
11. Study of Histopathological slides of benign and malignant tumours.
12. Study of Haematology slides of anemia and leukemia.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the fundamentals of biochemistry and functional aspects of living organisms.

CO2: Analyze structural functional aspects of biomolecules.

CO3: Explain the changes in the cell cycle and relevant diseases.

CO4: Explore the fluid properties.

CO5: Describe methods involved in treating the pathological diseases.

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TEXT BOOKS

1. Rafi MD "Text book of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021.
2. 2.Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 10th edition: South Asia Edition Elsevier India, 2020.
3. Ananthanarayanan & Panicker, "Microbiology" Orient blackswan, 2017 10th edition.

REFERENCE BOOKS

1. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017.
2. Donald Voet,Judith G.Voet,Charlotte W.Pratt , "Fundamentals of Biochemistry",5th edition ,Wiley,2016.
3. Hofmann A, "Wilson And Walkers Principles And Techniques Of Biochemistry And Molecular Biology" Cambridge University Press,8th edition 2018.
4. Master Medicine: "General and Systematic Pathology", Churchill Livingstone, 3rd edition, 2008.
5. D K Maheshwari, R C Dubey, "A Textbook of Microbiology" S.Chand , 4th edition 2013.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	2	-	-	-	-	-	-	-	3	-
CO2	2	3	3	2	2	-	-	-	-	-	-	-	3	-
CO3	2	3	3	2	2	-	-	-	-	-	-	-	3	-
CO4	2	3	3	2	2	-	-	-	-	-	-	-	3	-
CO5	2	3	3	2	2	-	-	-	-	-	-	-	3	-
AVG	**2**	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**3**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE2103 தமிழரும் தொழில்நுட்பமும் **L T P C**
1 0 0 1

பாடத்தின் நோக்கங்கள்

•மாணவர்கள் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தைக் கற்றறிதல்.

• கட்டிட மற்றும் உற்பத்தித் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்.

• வேளாண்மை, நீர்ப்பாசனம் மற்றும் அறிவியல் தமிழ், கணினித் தமிழ் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்.

அலகு I – நெசவு மற்றும் பானைத் தொழில்நுட்பம்

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் – சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும் கோயில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல் – மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சரசனிக் கட்டிடக்கலை.

அலகு III – உற்பத்தித் தொழில்நுட்பம்

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல் – எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு VI – வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

அணை, ஏரி, குளம், மதகு – சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V – அறிவியல் தமிழ் மற்றும் கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

பாடநெறி முடிவுகள்

பாடத்திட்டத்தை முடித்த பிறகு, மாணவர்கள் செய்யக் கூடியவை:

CO1: மாணவர்கள் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தைக் கற்றறிந்தனர்.

CO2: கட்டிடத் தொழில்நுட்ப முக்கியத்துவத்தை அறிந்து கொண்டனர்.

CO3: உற்பத்தித் தொழில்நுட்பத்தைக் கற்றறிந்தனர்.

CO4: வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பங்களைத் தெரிந்துகொண்டனர்.

CO5: அறிவியல் தமிழ் மற்றும் கணித் தமிழ் தொழில்நுட்பத்தை அறிந்துகொண்டனர்.

பாடப் புத்தகங்கள்

1. கே. கே. பிள்ளை, "தமிழக வரலாறு – மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம், 2004.
2. முனைவர் இல. சுந்தரம், "கணினித் தமிழ்", விகடன் பிரசுரம், 2015.
3. டாக்டர் எஸ். வி. சுப்ரமணியன், டாக்டர் கே. டி. திருநாவுக்கரசு, "தமிழர்களின் வரலாற்றுப் பாரம்பரியம்", சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர் சிங்காரவேலு, "தமிழர்களின் சமூக வாழ்க்கை", சர்வதேச தமிழாய்வு நிறுவனம்.
2. கீழடி – "வைகை ஆற்றின் கரையில் உள்ள சங்க நகர நாகரிகம் கூட்டு", தொல்லியல் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்விச் சேவைகள் கழகம், தமிழ்நாடு, 2015.
3. டாக்டர் கே. கே. பிள்ளை, "இந்திய வரலாறு", வெளியீடு ஆசிரியர்.
4. "பொருநை நாகரிகம்", தொல்லியல்துறை, தமிழ்நாடு பாடநூல் மற்றும் கல்விச் சேவைகள் கழகம்.
5. ஆர். பாலகிருஷ்ணன், "வைகை, சிந்து நாகரிகத்தின் பயணம்", வெளியீடு (EMRL).

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	-	-
AVG	-	-	-	-	-	**2**	-	**2**	-	-	-	-	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE2201 ENGINEERING PRACTICE LABORATORY **L T P C**

0 0 4 2

COURSE OBJECTIVES

- To develop practical skills in handling and assembling various components used in household plumbing, woodworking, welding, and electronic circuits.
- To provide hands-on experience in operating basic tools and equipment essential for engineering practices.
- To provide hands-on experience in domestic wiring procedures practically.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in-household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump, delivery side of a pump and pipes of different materials: Metal, plastic and flexible pipes used in house hold appliances.

WOOD WORK EXCERSIES:

a) Excises on sawing and planning of woods.
b) Prepare joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.
c) Studying joints in door panels, wooden furniture and common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES **15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets.
b) Staircase wiring.
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration.
e) Study of Iron Box wiring and assembly.
f) Study of Fan Regulator (Resistor type and Electronic type).

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GROUP – B (MECHANICAL & ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES **15**

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) Turning(simple).
b) Drilling and Tapping.

SHEET METAL WORK:

a) Making of a square tray.

STUDY AND ASSEMBLE THE FOLLOWING:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

FOUNDRY WORK:

a) Demonstrating of basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES **15**

a) Soldering simple electronic circuits and checking continuity.
b) Assembling and testing electronic components on a small PCB.
c) Study an element of smart phone.
d) Assembly and dismantle of LED TV.
e) Assembly and dismantle of computer.
f) Assembly and dismantle of laptop.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Proficiently connect and troubleshoot plumbing systems using various pipe fittings and materials.

CO2: Demonstrate competence in woodworking techniques including sawing, planing, and joint preparation.

CO3: Execute electrical wiring tasks, including switchboard installations and appliance connections.

CO4: Gain practical skills in welding, machining, sheet metal work, and foundry operations.

CO5: Assemble and test electronic devices such as PCBs, smartphones, LED TVs, and computers, enhancing their understanding of electronic assembly and testing procedures.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO2	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO3	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO4	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO5	3	3	3	2	2	-	-	-	2	-	-	2	2	-
AVG	3	3	3	2	2	-	-	-	2	-	-	2	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24MU3103 RANDOM PROCESSES AND LINEAR ALGEBRA **L T P C**

3 1 0 4

COURSE OBJECTIVES

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

UNIT I PROBABILITY AND RANDOM VARIABLES **9+3**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO – DIMENSIONAL RANDOM VARIABLES **9+3**

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

UNIT III RANDOM PROCESSES **9+3**

Classification – Stationary process – Markov process – Poisson process – Discrete parameter, Markov chain – Chapman Kolmogorov equations (Statement only) – Limiting distributions – Auto Correlation – Properties.

UNIT IV VECTOR SPACES **9+3**

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

UNIT V LINEAR TRANSFORMATION AND INNER PRODUCT SPACES **9+3**

Linear transformation – Null spaces and ranges – Dimension theorem – Matrix representation of linear transformations – Inner product – Norms – Gram Schmidt orthogonalization process – Adjoint of linear operations – Least square approximation.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Solve the probability and random variable problems.

CO2: Apply the one-dimensional random variable techniques for engineering applications.

CO3: Apply the random process techniques for solving correlation problems.

CO4: Apply the vector space method to solve the linear system of equations.

CO5: Apply the linear transformation for orthogonal problems.

TEXTBOOKS

1. Gross, D, Shortle, J.F, Thompson, J.M and Harris. C.M., "Fundamentals of Queuing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L, "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCE BOOKS

1. Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
4. Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
5. Kumaresan. S," Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**3**	-	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM3101 ANATOMY AND HUMAN PHYSIOLOGY **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To integrate the individual functions of all the cells and tissues and organs into functional whole, the human body.
- To understand the functional anatomy of the organs related to cardio vascular, respiratory, urinary and nervous system.
- To know the basic functioning of every system and the resultant unified organization.

UNIT I BASIC ELEMENTS OF HUMAN BODY **9**

Cell – Cell Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane - Action potential (Nernst, Goldman equation), Homeostasis. Tissue: Types, functions.

UNIT II SKELETAL AND MUSCULAR SYSTEM **9**

Skeletal: Types of Bone and function –Physiology of Bone formation –Division of Skeleton- Types of joints and function – Types of cartilage and function. –Types of muscles – Structure and Properties of Skeletal Muscle- Changes during muscle contraction- Neuromuscular junction.

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM **9**

Cardiovascular System: Structure – Conduction System of heart – Cardiac Cycle – Cardiac output. Blood: Composition – Functions - Haemostasis – Blood groups and typing. Blood Vessels – Structure and types - Blood pressure - Respiratory system: Parts of respiratory system – Respiratory physiology – Lung volumes and capacities – Gaseous exchange.

UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS **9**

Structure and functions of gastrointestinal system - secretary functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - structure of nephron - mechanism of urine formation - skin and sweat gland - temperature regulation.

UNIT V NERVOUS AND SENSORY SYSTEM **9**

Structure and function of nervous tissue – Brain and spinal cord – Functions of CNS – Nerve conduction and synapse – Reflex action – Somatic and Autonomic Nervous system. Physiology of Vision, Hearing, Integumentary, Olfactory systems. Taste buds.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Identify and explain basic elements of human body.

CO2: Explain the functions of skeletal and muscular system.

CO3: Describe the structure, function of cardiovascular system and respiratory system.

CO4: Discuss the structure of digestive and excretory system.

CO5: Describe the physiological process of Nervous and sensory system.

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TEXT BOOKS

1. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Ninth Edition, PearsonEducation, New Delhi, 2018.
2. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine", 3rd edition Springer, 2006. (Unit 2,3,4).
3. D. Venkatesh, H. H. Sudhakar, "Basics of Medical Physiology",4th edition, WOLTERS KLUWER, 2022.

REFERENCE BOOKS

1. Guyton & Hall, "Text book of Medical Physiology", 13th Edition, Saunders, 2015.
2. Ranganathan T S, "Text book of Human Anatomy", S.Chand & Co. Ltd., New Delhi, 2012.
3. Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", S. Chand and Company Ltd, New Delhi, 2012
4. Brodal.A, Neurological anatomy, Oxford University Press, 2nd Edition.
5. Dr. Monika Gupta , Dr. Abhishek Gupta, "Basics of The Human Body: A Beginner's Guide to Anatomy & Physiology", Kindle Edition.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO2	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO3	3	3	2	-	-	1	-	1	-	-	-	1	1	-
CO4	3	3	3	-	-	1	-	1	-	-	-	1	1	-
CO5	3	3	3	-	-	1	-	1	-	-	-	1	1	-
AVG	**3**	**3**	**2**	-	-	**1**	-	**1**	-	-	-	**1**	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM3102 ELECTRIC CIRCUIT ANALYSIS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology

UNIT I BASIC CIRCUITS ANALYSIS **9**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Laws, Mesh current and node voltage method of analysis for D.C and A.C. circuits. The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II NETWORK THEOREM AND DUALITY **9**

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, application of Network theorems. Network reduction: voltage and current division, source transformation, Delta-Wye Conversion. Duals, Dual circuits.

UNIT III SINUSOIDAL STEADY STATE ANALYSIS **9**

Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS **9**

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT V COUPLED CIRCUITS AND TOPOLOGY **9**

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Verifications of KVL & KCL.
2. Verifications of Thevenin theorem.
3. Verifications of Norton theorem.
4. Verification of Superposition Theorem.
5. Verification of maximum power transfer Theorem.
6. Verification of Reciprocity Theorem.
7. Determination of Resonance Frequency of Series & Parallel RLC Circuits.
8. Transient analysis of RL and RC circuits.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Comprehend and design ac / dc circuits.

CO2: Apply circuit theorems in real time.

CO3: Evaluate ac/dc circuits.

CO4: Analyze the electrical circuits

CO5: Develop and understand ac/dc circuits.

TEXT BOOKS

1. Hayt Jack Kemmerly, Steven Durbin," Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2. Joseph Edminister and Mahmood Nahvi,“ Electric Circuits”, Schaum’s Outline Series, Tata McGraw Hill Publishing Company, New Delhi, 5th Edition Reprint 2016.
3. Introductory Circuit Analysis, 14th Ed (Boylestad & Olivari, 2023).

REFERENCE BOOKS

1. Robert. L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.
2. John O Mallay, Schaum’s Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2ndEdition, 2011.
3. Charles. K. Alexander, Mathew N. O. Sadiku, "Fundamentals of Electric Circuits", Mc Graw Hill, 5thEdition, 2012.
4. Allan H. Robbins, Wilhelm C. Miller,“ Circuit Analysis Theory and Practice”, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.
5. A Practical Introduction to Electrical Circuits (John E. Ayers, 2024).

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-
CO2	3	3	2	3	-	-	-	-	-	-	-	-	1	-
CO3	3	3	2	3	-	-	-	-	-	-	-	1	1	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	1	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	1	-
AVG	3	3	2.4	2.2	-	-	-	-	-	-	-	1	1	-

1-Low, 2-Medium, 3-High, “-” – No correlation

24EC3101 DATA STRUCTURES AND C++ **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the basics of C programming language.
- To introduce the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.

UNIT I C PROGRAMMING FUNDAMENTALS **9**

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES **9**

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR AND NON-LINEAR DATA STRUCTURES USING C++ 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – DoublyLinked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Trees – Binary Trees – Tree Traversals –Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing.

UNIT IV SORTING AND SEARCHING TECHNIQUES USING C++ 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

UNIT V APPLICATIONS OF DATA STRUCTURES USING C++ 9

Stack: Postfix, Prefix, Infix expressions evaluation and conversion. Queue: Job Scheduling Problems - Graphs and Trees: Dijstra's Algorithm for shortest path - Prim's algorithm for Minimum spanning Trees - Searching and Indexing in Databases - Hash file organization.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

Using C

1. Array implementation of Stack, Queue and Circular Queue ADTs.
2. Implementation of Singly Linked List.
3. Linked list implementation of Stack and Linear Queue ADTs.

Using C++

1. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion.
2. Implementation of Dijkstra's Algorithm and Prim's Algorithm.
3. Implementation of Linear Search and Binary Search.
4. Implementation of Insertion Sort, Merge Sort and Selection Sort.
5. Implementation of Open Addressing (Linear Probing and Quadratic Probing).

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Develop C programs for any real world/technical application.

CO2: Apply advanced features of C in solving problems.

CO3: Write functions to implement linear and non–linear data structure operations.

CO4: Develop suggests and use appropriate linear/non–linear data structure operations for solving a given problem.

CO5: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

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TEXT BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.
3. Pradip Dey and Manas Ghosh, —"Programming in C", Second Edition, Oxford University Press, 2011.

REFERENCE BOOKS

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.
5. Jean-Paul Tremblay and Paul G. Sorenson, —"An Introduction to Data Structures with Applications", Second Edition, Tata McGraw-Hill, 1991.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	1	2	2	1	1	-	1	2	1	3	-	2
CO2	1	2	1	2	2	-	-	-	1	1	1	2	-	2
CO3	2	3	1	2	3	-	-	-	1	1	1	2	-	2
CO4	2	1	-	1	1	-	-	-	2	1	1	2	-	2
CO5	1	2	1	2	2	1	1	-	1	2	1	3	-	2
AVG	1.6	2.2	1	1.8	2	1	1	-	1.2	1.4	1	2.4	-	2

1-Low, 2-Medium, 3-High, "-" – No correlation

24EC3103 ELECTRONIC DEVICES AND CIRCUITS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components.
- To analyze the frequency response of small signal amplifiers.
- To design and analyze single stage and multistage amplifier circuits

UNIT I SEMICONDUCTOR DEVICES **9**

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator.

UNIT II AMPLIFIERS **9**

Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model–Analysis of CS, CG and Source follower – Gain and frequency response.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER **9**

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – MOSFET input stages – tuned amplifiers – Gain and frequency response.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages ofnegative feedback– Voltage / Current, Series , Shunt feedback Amplifiers – Positive feedback – Condition for oscillations, RC phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS **9**

Power amplifiers- class A-Class B-Class AB-Class C, Class AB–DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers.
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits.

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TEXT BOOKS

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7th Edition, 2014.

REFERENCE BOOKS

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits: Discrete & Integrated", McGraw Hill, 3rd Edition, 2002.
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.
4. L.Macdonald & A.C.Lowe, Display Systems, Wiley, 2003Robert Pierret, "Semiconductor Device Fundamentals," Pearson Education, 2006.
5. J.Millman and C.C.Halkias: Millman's Electronic devices and Circuits, McGraw Hill, 2015.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	2	1	-	-	-	-	-	1	-	1
CO2	3	2	2	3	2	2	-	-	-	-	-	1	-	1
CO3	3	3	3	2	1	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	2	2	-	-	-	-	-	1	-	1
CO5	3	2	2	2	2	1	-	-	-	-	-	1	-	1
AVG	**3**	**2.6**	**2.6**	**2.6**	**1.8**	**1.6**	-	-	-	-	-	**1**	-	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24EC3201 ELECTRONIC DEVICES AND CIRCUITS LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVES

- To learn the characteristics of PN Junction diode and Zener diode.
- To understand the operation of rectifiers and filters.
- To design and analyze the characteristics of amplifier.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode and Zener diode.
2. Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
4. Common Emitter input-output Characteristics.
5. MOSFET Drain current and Transfer Characteristics.
6. Frequency response of CE and CS amplifiers.
7. Frequency response of CB and CC amplifiers.
8. Frequency response of Cascode Amplifier.
9. CMRR measurement of Differential Amplifier.
10. Class A Transformer Coupled Power Amplifier.
11. Analysis of Cascode and Cascade amplifiers using Spice.
12. Analysis of Frequency Response of BJT and FET using Spice.

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COURSE OUTCOMES

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

CO1: Explain the Characteristics of PN Junction Diode and Zener diode.

CO2: Design and analyze the Design and Testing of BJT and MOSFET amplifiers.

CO3: Analyze the Operation of power amplifiers.

CO4: Design and analyze feedback amplifiers and oscillator principles.

CO5: Design and analyze power amplifiers and supply circuits.

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	3	2	1	-	-	-	-	1	2	-	2
CO2	2	2	3	3	2	1	-	-	-	-	1	2	-	2
CO3	2	-	2	3	1	1	-	-	-	-	1	2	-	2
CO4	-	-	-	-	3	1	-	-	-	-	1	2	-	-
CO5	-	-	-	-	2	1	-	-	-	-	1	2	-	-
AVG	**2**	**2**	**2.6**	**3**	**2**	**1**	-	-	-	-	**1**	**2**	-	**2**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM3201 ANATOMY AND HUMAN PHYSIOLOGY LABORATORY **L T P C**

3 0 0 1.5

COURSE OBJECTIVES

- To develop practical skills in hematology and blood analysis.
- To enhance proficiency in microscopic techniques and histological analysis.
- To understand and record electrical activity in human physiology.

LIST OF EXPERIMENTS

1. Collection of Blood Samples.
2. Identification of Blood groups (Forward and Reverse).
3. Bleeding and Clotting time.
4. Estimation of Hemoglobin.
5. Total RBC and WBC Count.
6. Differential count t of Blood cells.
7. Estimation of ESR, PCV, MCH, MCV, MCHC.
8. Hearing test – Tuning fork.
9. Visual Activity – Snellen's Chart and Jaeger's Chart.
10. Preparation of slices from tissue, fixation and examination under microscope.
11. Preparation of blood film, staining and examination under microscope.
12. Recording the ECG, EEG and EMG signal.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Develop Proficiency in Hematological Techniques.

CO2: Enhance Microscopic Examination Skills.

CO3: Explore and Record Electrical Activity in Human Physiology.

CO4: Assess Sensory Functions through Practical Tests.

CO5: Apply Laboratory Techniques to Study Hematological Parameters.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	3	1	-	-	-	3	2	-	1	1	-
CO2	2	2	3	3	1	-	-	-	3	2	-	1	1	-
CO3	2	2	3	3	1	-	-	-	3	2	-	1	1	-
CO4	2	2	3	3	1	-	-	-	3	2	-	1	1	-
CO5	2	2	3	3	1	-	-	-	3	2	-	1	1	-
AVG	2	2	3	3	1	-	-	-	3	2	-	1	1	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM4101 BIOSENSORS AND MEASUREMENTS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and different display and recording devices.
- To learn the different bridges for measurement and various type of biosensors.

UNIT I FUNDAMENTALS OF MEASUREMENTS **9**

Measurement System –Instrumentation -Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis- methods of error analysis, - uncertainty analysis-expression of uncertainty: accuracy and precision index, propagation of errors– Calibration - Primary and secondary standards.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS **9**

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.

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UNIT III PHOTOELECTRIC AND PIEZOELECTRIC SENSORS 9

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

UNIT IV SIGNAL CONDITIONING CIRCUITS AND METERS 9

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q- meter, PMMC, MI and dynamometer type instruments - DC potentiometer- Digital voltmeter – Multi meter.

UNIT V RECORDING DEVICES AND ADVANCED SENSORS 9

CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification - Electronic nose.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Measure various electrical parameters with accuracy, precision, resolution.

CO2: Select appropriate passive or active transducers for measurement of physical phenomenon.

CO3: Select appropriate light sensors for measurement of physical phenomenon

CO4: Use AC and DC bridges for relevant parameter measurement.

CO5**:** Employ multi meter, CRO and different types of recorders for appropriate measurement.

TEXT BOOKS

1. 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",4thedition, 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.

REFERENCE BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, New Delhi, 2014.
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
3. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1stedition, 2016.
4. D.Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall of India, 2010.
5. E.A.Murthy, D.V.S., Transducers and Instrumentation, 2ndEdition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	1	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	1	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	1	-
AVG	**3**	**3**	**2**	**1.4**	-	-	-	-	-	-	-	-	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM4102 ANALOG AND DIGITAL INTEGRATED CIRCUITS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- To introduce the design of various combinational digital circuits using logic gates and synchronous and asynchronous sequential circuits

UNIT I INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS **9**

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multi vibrator and Schmitt trigger, Triangular wave generator.

UNIT II DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL **9**

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter - Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator**.**

UNIT III THE BASIC GATES AND COMBINATIONAL LOGIC CIRCUITS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Min terms and Max terms, Karnaugh map and Tabulation methods. Logic families-TTL, MOS, CMOS, Bi CMOS - Comparison of Logic families.

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UNIT IV COMBINATIONAL LOGIC CIRCUITS **9**

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux / Demux.

UNIT V SEQUENTIAL LOGIC CIRCUITS **9**

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, and circuit implementation. 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Design new analog linear circuits and develop linear IC based Systems.

CO2: Apply the concept of ADC and DAC in real time systems and Phase Locked Loop with applications.

CO3: Use Boolean algebra and apply it to digital systems.

CO4: Design various combinational digital circuits using logic gates.

CO5: Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

TEXT BOOKS

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Mc Graw Hill Education, 3rd Edition, 2017.
2. John. F. Wakerly, “Digital design principles and practices”, Pearson Education, 5th Edition, 2018.
3. S. Haykin “Digital Communications” John Wiley 2005.

REFERENCE BOOKS

1. Taub and Schilling, “Digital Integrated Electronics”, McGraw Hill,2017.
2. Charles H. Roth, Jr, “Fundamentals of Logic Design”, Jaico Books, 7th Edition, 2013.
3. M. Morris Mano and Michael D. Ciletti, “Digital Design”, Pearson, 5thEdition,2013.
4. S. Salivahanan and VS Kanchana Bhaaskaran, “Linear Integrated Circuits”, McGraw-Hill Education, 3rd Edition, 2018.
5. B.P. Lathi, “Modern Digital and Analog Communication Systems”,3/e, Oxford University Press, 2007.

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Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	2
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	2
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	2
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	2
AVG	**3**	**2**	**1**	**1**	**1**	-	-	-	-	-	-	-	**1**	**2**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM4103 SIGNAL AND SIGNAL PROCESSING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand about the continuous time and discrete time signals and systems.
- To learn the analysis of LTI systems using Laplace and Z transform.
- To represent the signal in frequency domain using FFT and To gain knowledge about the design of IIR and FIR filters.

UNIT I FUNDAMENTALS OF SIGNALS AND SYSTEMS **9**

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II ANALYSIS OF LTI SYSTEMS **9**

Fourier series - Fourier Transform and Properties, Analysis of Continuous Time LTI Systems -Z Transform-Properties of ROC–Inverse Z Transform–DTFT- Analysis of Discrete Time LTI Systems.

UNIT III DISCRETE FOURIER TRANSFORM **9**

DFT and its properties, magnitude and phase representation-Linear Convolution- Correlation-Circular Convolution, Overlap-add and overlap-save methods. FFT – Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

UNIT IV INFINITE IMPULSE RESPONSE FILTERS **9**

Analog filters – Butterworth filters, Chebyshev Type I filters (up to 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade and parallel forms.

UNIT V FINITE IMPULSE RESPONSE FILTERS AND MULTIRATE SIGNAL PROCESSING **9**

Design of linear phase FIR filters - windowing and Frequency sampling methods. Realization structures for FIR filters – Transversal and Linear phase structures, Comparison of FIR and IIR. Introduction to DSP processors. Introduction to Multi rate signal Processing – Decimation and Interpolation.

TOTAL: 45 PERIODS

LIST OF EXEPERIMENTS

1. Construction of signals with different Frequencies.
2. Linear and Circular convolutions.
3. Auto correlation and Cross Correlation.
4. Reconstruct a signal from samples and study the effect of Aliasing.
5. Spectrum Analysis using FFT.
6. Filter Design & Analysis.
7. Multi rate Signal Processing.
8. DSP Processor Implementation. (FFT implementation, IIR and FIR filters implementation).

COURSE OUTCOMES

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

CO1: Classify the continuous time and discrete time signals and systems.
CO2: Analyze the signals in both continuous time and discrete time.
CO3: Apply DFT for the analysis of digital signals & systems.
CO4: Design IIR filter to process real world signals.
CO5: Design FIR filter to process real world signals.

TOTAL: 30 PERIODS

TEXT BOOKS

1. Allan V. Oppenheim, S. Wilsky and S.H. Nawab, “Signals and systems”, Pearson, Indian Reprint, 2nd Edition, 2015.
2. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson, 4 th Edition, 2014.
3. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.

REFERENCE BOOKS

1. S. Haykinand B. Van Veen, “Signals and Systems”, Wiley, 2nd Edition, 2007
2. B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford, 2nd Edition,2009.
3. Emmanuel Ifeachor, Barrie Jervis,“ Digital Signal Processing - A practical approach”, Pearson, 2nd Edition, 2002.
4. M. H. Hayes, “Digital Signal Processing, Schaum’s outlines”, Tata McGraw Hill, 2nd Edition, 2011.
5. B. P. Lathi, “Modern Digital and Analog Communication Systems”,3/e, Oxford University Press, 2007.

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Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	-	-	-	-	-	1	-	-	2	1
CO2	3	2	2	2	-	-	-	-	-	1	-	-	2	1
CO3	3	2	2	2	-	-	-	-	1	1	-	-	2	1
CO4	3	2	2	2	1	-	-	-	1	1	1	-	2	1
CO5	3	2	2	2	1	-	-	-	1	1	1	-	2	1
AVG	**3**	**2**	**2**	**2**	**1**	-	-	-	**1**	**1**	**1**	-	**2**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM4104 BIO CONTROL SYSTEMS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the concept behind feedback and continuum in various systems and sub systems and the need for mathematical modeling of various systems.
- To analyze the systems in time and frequency domains.
- To understand the concept of stability of various systems.

UNIT I INTRODUCTION **9**

Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.

UNIT II TIME RESPONSE ANALYSIS **9**

Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.

UNIT III STABILITYANALYSIS **9**

Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability.

UNIT IV FREQUENCY RESPONSE ANALYSIS **9**

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

UNIT V BIOLOGICAL CONTROL SYSTEM ANALYSIS **9**

Simple models of muscle stretch reflex action - steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

TOTAL: 45 PERIODS

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LIST OF EXEPERIMENTS

1. Mathematical modelling of mechanical translational system.
2. Step response of a First order system.
3. Step response of a second order system.
4. Root Locus – based analysis in simulation platform.
5. Stability study of a Linear System using Bode Plot.
6. Stability Analysis by Frequency Response Methods using polar plot
7. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform
8. Physiological control systems design using MATLAB.

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Interpret the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems.

CO2: Determine the time response of various systems.

CO3: Discuss the concept of system stability.

CO4: Examine the frequency response characteristics of various systems using different charts.

CO5: Appraise the concept of modeling basic physiological systems.

TEXT BOOKS

1. J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1st September, 2018.
2. Michael CKKhoo, Physiological Control Systems, IEEE Press, Prentice Hall India, 2005.
3. Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, Impression 2009.

REFERENCE BOOKS

1. Salivahanan S, Rengaraj R and Venkatakrishnan G.R., Control Systems Engineering, Pearson Education India, 2015.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3. Ogata, Katsuhiko and YanjuanYang, Modern control engineering, Vol 4, Prentice-Hall, 2002.
4. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, Taylor & Francis, "Linear Control System Analysis and Design with MATLAB", CRC Reprint 2009.
5. NPTEL Video Lecture Notes on "Control Engineering" by Prof. S.D. Agashe, IIT Bombay.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	1
CO2	3	2	2	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	1
CO4	3	2	2	2	1	-	-	-	-	-	-	-	2	1
CO5	3	2	2	2	1	-	-	-	-	-	-	-	2	1
AVG	3	2	2	2	1	-	-	-	-	-	-	-	2	1

1-Low, 2-Medium, 3-High, "-" – No correlation

24CY4101 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**
2 0 0 2

COURSE OBJECTIVES

- To introduce the fundamental ideas of environment and interrelationship between living organism.
- To impart knowledge on pollution and perspectives on renewable resources.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials.

UNIT I ENVRONMENT AND BIODIVERSITY **6**

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

UNIT II NATURAL RESOURCES **6**

Forest resources: deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: over-utilization of surface and ground water. Mineral resources: environmental effects of extracting and using mineral resources. Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

UNIT III ENVIRONMENTAL POLLUTION **6**

Causes, Effects and Preventive measures of Water, Soil and Air Pollution. Environmental protection acts [Environment Act, Air Act, Water Act]. Disaster management: causes - effects - control measures of floods – earthquake.

UNIT IV NON-CONVENTIONAL ENERGY **6**

Energy management and conservation, New Energy Sources: Solar energy, Wind energy, Biomass energy, Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

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UNIT V SUSTAINABILITY MANAGEMENT **6**

Sustainable development, Unsustainability to sustainability, GDP, Carbon Credit, Carbon Footprint, Zero waste and R concept, Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports, Green Engineering.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the functions of environment, ecosystems and biodiversity.
CO2: Examine the relationship between natural resources and their environment.
CO3: Identify the causes, effects of environmental pollution.
CO4: Recognize the sources of Non-conventional energy.
CO5: Explain the needs of sustainable development and green materials.

TEXT BOOKS

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

REFERENCES

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

Mapping of Cos with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO4	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO5	2	2	-	-	-	-	3	-	-	-	-	-	-	-
AVG	2	2	-	-	-	-	3	-	-	-	-	-	2	-

1-Low,2 -Medium, 3– High, '-' No correlation

24BM4201 SENSORS AND MEASUREMENTS LABORATORY **L T P C**
0 0 3 1.5

COURSEOBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, simulations with a futuristic vision along with socio-economic impact and issues.
- To study the characteristics of signal conditioning circuits.
- To study the characteristics of sensors and display devices.

LIST OF EXPERIMENTS

1. Calibration of voltmeter and ammeter using shunt type Potentiometer.
2. Characteristics of thermistor and thermocouple.
3. Characteristics of LDR.
4. Characteristics of Photo Diode.
5. Characteristics of RTD.
6. Characteristics of LVDT.
7. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone Bridge.
8. Measurement of unknown Capacitance using Schering Bridge.
9. Measurement of unknown Inductance using Maxwell's & Hay's Bridge.
10. Characteristics of Hall effect transducer.
11. Characteristics of strain gauge.
12. Characteristics of Piezo electric Transducer.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Design and understand characteristics and calibration of various transducers.
CO2: Design and develop bridge circuits to find unknown variables.
CO3: Select proper transducer for various applications.
CO4: Explore various read out and display devices.
CO5: Design a measurement system for various applications

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	2	-	-	-	-	1	2	-	-	2	-
CO2	3	2	1	1	-	-	-	-	1	2	-	-	2	-
CO3	3	2	1	1	-	-	-	-	1	2	-	-	2	-
CO4	3	2	1	2	-	-	-	-	1	2	1	-	2	-
CO5	3	2	1	1	-	-	-	-	1	2	1	-	2	-
AVG	**3**	**2**	**1**	**1.4**	-	-	-	-	**1**	**2**	**1**	-	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BM4202 ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY **L T P C 0 0 3 1.5**

COURSE OBJECTIVES

- To design digital logic circuits and circuits for generating waveforms using ICs.
- To learn the function of different ICs and working of multi vibrators.
- To understand the applications of operation amplifier.

LIST OF EXPERIMENTS

1. Inverting, non-inverting amplifier and comparator.
2. Integrator and Differentiator.
3. Design and analysis of active filters using op-amp.
4. Schmitt trigger using operational amplifier.
5. Instrumentation amplifier using operational amplifier.
6. Multi vibrators using IC555 Timer.
7. Study of logic gates, Half adder and Full adder.
8. Encoder and BCD to7 segment decoder.
9. Multiplexer and demultiplexer using digital ICs.
10. Universal shift register using flip flops.
11. Design of mod-N counter.
12. Simulation and analysis of circuits using software.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Design Combinational Circuits using logic gates.

CO2: Design and implement arithmetic circuits for different applications using op amp.

CO3: Design Sequential Circuits using logic gates.

CO4: Design waveform generators and analyze their characteristics.

CO5: Simulate and analyze circuits using ICs.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	-	-	-	1	1	-	-	1	-
CO2	3	3	1	1	1	-	-	-	1	1	-	-	1	-
CO3	3	3	1	1	1	-	-	-	1	1	1	-	1	-
CO4	3	3	1	1	1	-	-	-	1	1	1	-	1	-
CO5	3	3	1	1	1	-	-	-	1	1	1	-	1	-
AVG	**3**	**3**	**1**	**1**	**1**	-	-	-	**1**	**1**	**1**	-	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24GE4201 TECHNICAL SEMINAR **L T P C**

0 0 2 1

COURSE OBJECTIVES

- To gain knowledge on literature survey in a selected area of study.
- To know an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

COURSE SUMMARY

The course 'Technical Seminar' is anticipated to support a B.E./B.Tech graduate to read, understand, present and prepare report of an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his Technical seminar coordinator/guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

GENERAL GUIDELINES

1. The Department shall form an Internal Evaluation Committee (IEC) for the seminar for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members.
2. During the seminar presentation of a student, all members of IEC shall be present.
3. Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
4. Guide shall provide required input to their students regarding the selection of topic/ paper.

Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern (Only internal evaluation)

Guide: (i) 20 marks (Background Knowledge – 10 & Relevance of the paper/topic selected – 10).

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Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES

CO1: Identify academic documents from the literature which are related to her/his areas of interest.

CO2: Read and apprehend an academic document from the literature which is related to her/ his areas of interest.

CO3: Prepare a presentation about an academic document.

CO4: Give a presentation about an academic document.

CO5: Prepare a technical report.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	2	-	-	-	-	2	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	2	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	2	-	3	-	-
CO4	3	3	-	-	2	-	-	-	-	2	-	3	-	-
CO5	3	3	-	-	2	-	-	-	-	2	-	3	-	-
AVG	2.8	2.6	-	-	2	-	-	-	-	2	-	3	-	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24BM5101 BIOMEDICAL INSTRUMENTATION **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To explain the different techniques used for measurement of non-electrical bio parameters.
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I ELECTRODE CONFIGURATIONS **9**

Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT II BIOSIGNAL CHARACTERISTICS **9**

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III BIOAMPLIFIERS **9**

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT IV MEASUREMENT OF BIO SIGNALS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements.

UNIT V BIOCHEMICAL MEASUREMENTS **9**

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Illustrate the origin of various biological signals and their characteristics.

CO2: Gain knowledge on characteristics of bio signals.

CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of biosignals.

CO4: Explain the different measurement techniques for non-electrical bio-parameters.

CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment.

TEXT BOOKS

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition Tata Mc Graw Hill, New Delhi, 2014.

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REFERENCE BOOKS

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press,2005.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology" , Pearson Education, 2004.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill 2003.
4. Joseph D. Bronzino (Editor),"Biomedical Engineering Handbook, Volume 1, 2nd Edition", December 2000, ISBN: 0-849-30461-X.
5. Barbara L. Christe, "Introduction to Biomedical Instrumentation", 2nd Edition December 2017.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	2	-	-	-	-	-	-	1	-	2	-
CO5	3	2	1	1	-	-	-	-	-	-	1	-	2	-
AVG	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24EC5104 MICROPROCESSORS AND MICROCONTROLLERS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the architecture of 8086 microprocessor.
- To learn the design aspects of I/O and memory interfacing circuits.
- To study and design the architecture of 8051 micro controller.

UNIT I INTRODUCTION OF 8086 MICROPROCESSOR **9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE **9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure –Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O INTERFACING **9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

.

UNIT IV MICROCONTROLLER **9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER **9**

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Execute programs based on 8086 microprocessor.
CO2: Design Memory Interfacing circuits.
CO3: Design and interface I/O circuits.
CO4: Design and implement 8051 microcontroller based systems.
CO5: Design 8051 microcontroller with interfacing circuits.

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TEXT BOOKS

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
3. R. Gaonkar - Microprocessor Architecture, Programming and Applications with the 8086, 5th edition Pearson education, 2002.

REFERENCE BOOKS

1. Doughlas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
2. A.K. Ray, K.M. Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd Edition, Tata Mc Graw Hill, 2012
3. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, TMH, 2nd. Edition 2006.
4. S. Furber, “ARM system On Chip Architecture”, Second Edition, Pearson, 2015.
5. A. Sloss, D. Symes, C. Wright, “ARM System Developer's Guide: Designing and Optimizing System Software”, First Edition, Elsevier, 2004.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	1	-	-	-	-	-	-	1	2	1
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	-	-	-	1	2	1
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	1
CO5	3	2	1	-	1	-	-	-	-	-	-	1	2	1
AVG	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM5102 BIOMATERIALS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- Understand different metals, ceramics and its nano material characteristics as biomaterials.
- Learn polymeric materials and its combinations that could be used as a tissue replacement implants.
- Understand the concept of bio compatibility and the methods for bio materials testing.

UNIT I INTRODUCTION TO BIO-MATERIALS **9**

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS **9**

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, 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 TISSUE REPLACEMENT IMPLANTS **9**

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials**.**

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UNIT V TESTING OF BIOMATERIALS **9**

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

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Measure the Rockwell Hardness for ferrous and non-ferrous biomaterials.
2. Measure the Brinell Hardness for ferrous and non-ferrous biomaterials.
3. Measure the Vicker's Hardness for ferrous and non-ferrous biomaterials.
4. Test a specimen by using torsion testing machine.
5. Determine the tensile and compressive strengths of implant materials.
6. Determine the surface roughness of different implant materials.
7. Analyze the Polymerization process and techniques suitable for different implants.
8. Study on analysis of biomaterials with respect to Size, Position, load and resection.

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze different types of Bio-materials and its classification and apply the concept of nanotechnology towards bio-materials use.

CO2: Identify significant gap required to overcome challenges and further development in metallic and ceramic materials.

CO3: Identify significant gap required to overcome challenges and further development in polymeric materials.

CO4: Create combinations of materials that could be used as a tissue replacement implant.

CO5: Explore the testing standards applied for bio-materials.

TEXTBOOKS

1. Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. Joon B. Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press,2003
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003

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REFERENCE BOOKS

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 Krati Jain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.
3. C. Mauli Agarwal, Joo L.Ong,Mark R. Appleford, Gopinath Mani, "Biomaterials-Basic Theory with Engineering Applications" Cambridge University Press, New York- 2016.
4. John Enderle, Joseph D. Bronzino, Susan M. Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
5. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1987.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO2	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO3	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO4	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO5	3	3	1	1	1	-	-	-	-	-	-	1	1	-
AVG	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BM5103 MEDICAL IMAGE PROCESSING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the concepts of various image intensity transformation and filtering operations.
- To be familiar in the techniques of segmentation and restoration of medical images.
- To gain knowledge in medical image registration and visualization.

UNIT I FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS **9**

Overview of Image Processing system and human Visual system- Image representation – pixel and voxels, Gray scale and color models- Medical image file formats- DICOM, ANALYZE 7.5, NIFTI and INTERFILE- Discrete sampling model and Quantization- Relationship between the pixels, Arithmetic and logical operations- Image quality and Signal to Noise ratio- Image Transforms- 2D DFT, DCT, KLT.

UNIT II ENHANCEMENT TECHNIQUES **9**

Gray level transformation- Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing- Histogram equalization, Histogram Matching. Spatial domain Filtering-Smoothing filters, sharpening filters. Frequency domain filtering- Smoothing filters, Sharpening filters- Homomorphic filtering -Medical image enhancement using Hybrid filters Performance measures for enhancement techniques-DICOM.

UNIT III SEGMENTATION AND RESTORATION TECHNIQUES **9**

ROI definition -Detection of discontinuities–Edge linking and boundary detection – Region based segmentation- Morphological processing, Active contour models. Image Restoration-Noise models– Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering- linear position- Invariant degradation- Estimation of degradation function, Inverse filter, Weiner filtering.

UNIT IV REGISTRATION AND VISUALISATION **9**

Registration–Rigid body transformation, principal axes registration, and feature based.
Visualisation-Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image.

UNIT V APPLICATIONS OF MEDICAL IMAGE ANALYSIS **9**

Medical Image compression- DCT and Wavelet transform based image compression, Preprocessing of medical images -Retinal images, Ultrasound –liver, kidney, Mammogram. Segmentation of ROI -blood vessels, lesions, tumour, lung nodules, feature extraction- shape and texture.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Image sampling and quantization.
2. Analysis spatial and intensity resolution and transformation of images.
3. DFT analysis of images.
4. Histogram Processing and Basic Thresholding functions.
5. Image Enhancement Spatial filtering and in frequency domain.
6. Basic Morphological operation and segmentation using watershed transformation.
7. Analysis of images with different color models.
8. Image Compression techniques and restoration.

TOTAL : 30 PERIODS

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COURSE OUTCOMES

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

CO1: Explain and apply the fundamental concepts of image processing techniques for the analysis of medical images.

CO2: Identify and apply suitable filtering and intensity transformation techniques for given medical applications.

CO3: Identify and segment the Region of Interest from the given medical image.

CO4: Explore and apply current research in registration and visualization for medical image analysis.

CO5: Design and evaluate the use of image processing fundamentals in healthcare applications, as well as their impact on health and society, and any underlying ethical issues, then communicate effectively through reflections, reports, and presentations.

TEXT BOOKS

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

REFERENCE BOOKS

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

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO2	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO3	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO4	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO5	3	3	1	1	1	-	-	-	-	-	-	1	1	1
AVG	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM5201 BIOMEDICAL INSTRUMENTATION LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES

- To study and design Bio amplifiers.
- To provide hands on training on Measurement of physiological parameters.
- To study and design bio signals using digital circuits.

LIST OF EXPERIMENTS

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's.
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier.
4. Design of frontal EEG amplifier.
5. Design a right leg driven ECG amplifier.
6. Design and study the characteristics of optical Isolation amplifier.
7. Design a Multiplexer and Demultiplexer for any two biosignals.
8. Measurement of pulse-rate using Photo transducer.
9. Measurement of pH and conductivity.
10. Measurement of blood pressure using sphygmomanometer.
11. Measurement and recording of peripheral blood flow.
12. Design a PCB layout for any bio amplifier using suitable software tool.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Design the amplifier for Bio signal measurements.

CO2: Measure heart rate and heart sounds.

CO3: Record and analyze pulse rate and respiration rate.

CO4: Measure blood pressure and blood flow.

CO5: Design isolation amplifier.

Mapping of COs with POs and PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO2	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO3	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO4	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO5	3	3	1	1	1	1	-	-	1	1	1	-	1	1
AVG	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24EC5202 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY **L T P C 0 0 3 1.5**

COURSE OBJECTIVES

- To Introduce ALP concepts, features and Coding methods.
- Write ALP for arithmetic and logical operations in 8086 and 8051.
- Interface different I/Os with Microprocessors.

LIST OF EXPERIMENTS

8086 Programs using kits

1. Basic arithmetic and Logical operations.
2. Move a data block without overlap.
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching.

Peripherals and Interfacing Experiments

1. Traffic light controller.
2. Stepper motor control.
3. Key board and Display.
4. Serial interface and Parallel interface.
5. A/D and D/A interface and Waveform Generation.

8051 Experiments using kits and MASM

1. Basic arithmetic and Logical operations.
2. Square and Cube program, Find 2's complement of a number.
3. Unpacked BCD to ASCII.

COURSE OUTCOMES

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

CO1: Write ALP Programmes for fixed and floating point and arithmetic operations.
CO2: Interface different I/Os with processor.
CO3: Generate waveforms using Microprocessors.
CO4: Execute Programs in 8051.
CO5: Explain the difference between simulator and emulator.

TOTAL:45 PERIODS

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	3	1	1	-	-	-	-	-	-	-	-	2	1
CO3	1	2	2	2	-	-	-	-	-	-	1	1	2	2
CO4	-	1	3	3	1	-	-	-	-	-	1	1	2	2
CO5	3	3	3	3	1	-	-	-	-	-	1	1	2	2
AVG	**2.3**	**2.3**	**2.3**	**2.3**	**1**	-	-	-	-	-	**1**	**1**	**2**	**2**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM6101 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To illustrate the working of various equipment used for measuring the cardiac, neurological and muscular functions.
- To demonstrate ECG and EEG system maintenance and troubleshooting.
- To explain diagnostic and therapeutic devices related to respiratory and sensory parameters.

UNIT I CARDIAC EQUIPMENT **9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT II NEUROLOGICAL EQUIPMENT **9**

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

UNIT III MUSCULAR AND BIOMECHANICAL EQUIPMENT **9**

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.

UNIT IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM **9**

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

UNIT V SENSORY DIAGNOSTIC EQUIPMENT **9**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Explain the working and recording of all basic neurological equipment.
CO3: Discuss the recording of diagnostic and therapeutic equipment’s related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses.

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012.
3. Richard Aston "Principles of Biomedical Instrumentation and Measurement" Merril Publishing Company, 1990.

REFERENCE BOOKS

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

Mapping of COs, with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	3	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	3	-
AVG	3	2	1	-	1	-	-	-	-	-	-	1	3	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM6102 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN BIOMEDICINE **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To learn techniques for reasoning under uncertainty.
- To introduce Machine Learning and supervised learning algorithms.
- To study about ensembling and unsupervised learning algorithms.

UNIT I PROBLEM SOLVING **9**

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).

UNIT II PROBABILISTIC REASONING **9**

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT III SUPERVISED LEARNING **9**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT V APPLICATIONS OF AI IN BIOMEDICINE **9**

AI in Personalized Medicine and Treatment Planning, Pharmacogenomics and precision medicine, Treatment recommendation systems, Ethical, Legal, and Social Implications (ELSI) of AI in Medicine, Regulation and policy considerations for AI in healthcare.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Use appropriate search algorithms for problem solving.

CO2: Apply reasoning under uncertainty.

CO3: Build supervised learning models.

CO4: Build ensembling and unsupervised models.

CO5: Build deep learning neural network models.

TEXT BOOKS

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.
3. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014.

REFERENCE BOOKS

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007.
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
4. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/).
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

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Mapping of COs, with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO2	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO3	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO4	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO5	3	3	1	1	1	1	-	-	1	1	1	-	1	1
AVG	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM6201 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY **L T P C 0 0 3 1.5**

COURSE OBJECTIVES

- To demonstrate recording and analysis of different Bio potentials.
- To examine different therapeutic modalities.
- To analyse the different bio signals using suitable tools.

LIST OF EXPERIMENTS

1. Measurement of visually and auditory evoked potential.
2. Galvanic skin resistance (GSR) measurement.
3. Measurement of output intensity from shortwave and ultrasonic diathermy.
4. Measurement of various physiological signals using biotelemetry.
5. Electrical safety measurements.
6. Measurement of stimulation current waveforms used in medical stimulator.
7. Recording of Audiogram.
8. Study the working of Defibrillator and pacemakers.
9. Study of ECG, EEG and EMG electrodes.
10. Study of ventilators and Ultrasound Scanners.
11. Study of speech signals using speech signal trainer kit.
12. Measurement of Oxygen Saturation and Heart Rate using Pulse-oximeter.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1: Measure the different bioelectrical signals.

CO2: Record the various physiological signals using telemetry.

CO3: Demonstrate various diagnostic and therapeutic techniques.

CO4: Examine the electrical safety measurements.

CO5: Analyse the different bio signals using suitable tools.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	1	-	-	-	-	-	-	1	3	1
CO2	3	2	1	-	1	-	-	-	-	-	-	1	3	1
CO3	3	2	1	-	1	-	-	-	-	-	-	1	3	1
CO4	3	2	1	-	1	-	-	-	-	-	-	1	3	1
CO5	3	2	1	-	1	-	-	-	-	-	-	1	3	1
AVG	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BM6202 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY **L T P C 0 0 3 1.5**

COURSE OBJECTIVES

- To foster research, development, and application of AI and ML technologies.
- To provide the development of AI solutions for real-world problems.
- To design and implement distributed systems for information exploitation, collaboration, and decision-making.

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LIST OF EXPERIMENTS

1. Implementation of Uninformed search algorithms (BFS, DFS).
2. Implementation of Informed search algorithms (A*, memory-bounded A*).
3. Implement naïve Bayes models.
4. Implement Bayesian Networks.
5. Build Regression models.
6. Build decision trees and random forests.
7. Build SVM models.
8. Implement ensembling techniques.
9. Implement clustering algorithms.
10. Implement EM for Bayesian networks.
11. Build simple NN models.
12. Build deep learning NN models.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Use appropriate search algorithms for problem solving.

CO2: Apply reasoning under uncertainty.

CO3: Build supervised learning models.

CO4: Build ensembling and unsupervised models.

CO5: Build deep learning neural network models.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO2	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO3	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO4	3	3	1	1	1	1	-	-	1	1	1	-	1	1
CO5	3	3	1	1	1	1	-	-	1	1	1	-	1	1
AVG	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24PD6201 NCC/NSS/NSO **L T P C**

2 0 0 2

All students shall enroll on admission in any one of the personality and character development program. NCC/NSS/NSO/YRC/SPORTS is a mandatory requirement and undergo training / conduct activities for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first aid. Alternately activities of science, literature and arts also help for personality and character development. The training activities will normally be during weekends and the camp will normally be during vacation period. A certificate will be given by the authorities concerned and duly forwarded by the Head of the Department to the Controller of Examinations for the purpose of record and scrutiny. No fee shall be charged for all these activities.

(OR)

Enroll as a student member of a recognized professional society/other bodies such as

- Student Chapters of Institution of Engineers (India)/ISTE/ Department Association
- Student Chapters of other Professional bodies like ICI, IEEE, SAE, ASHRAE, CSI, IEI, IIC, IGS, IETE, IWS etc. Students will have activities to improve technical skills, innovative skills, and career development.

24HS7101 PROFESSIONAL ETHICS IN ENGINEERING **L T P C**

2 0 0 2

COURSE OBJECTIVES

- To enable the students to create an awareness on professional ethics.
- To impart moral and social values.
- To learn the moral leadership and corporate responsibility.

UNIT I SOCIAL ETHICS **6**

Application of ethical reasoning to social problems – Gender bias and issues –Social discrimination – Constitutional protection and policies – Inclusive practices. Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

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UNIT II ENGINEERING ETHICS **6**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III SCIENTIFIC ETHICS **6**

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **6**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **6**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Describe the human values with regard to the individual lifestyle for the society.

CO2: Explain the role of ethics to the engineering field.

CO3: Describe how engineering is applied in association with ethics based on engineering experimentation.

CO4: Explain the engineering ethics-based safety, responsibilities and rights.

CO5: Discuss the global issues of professional ethics in engineering.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering". McGraw-Hill, New York, 2005.
2. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, Oxford, 2001.
3. Charles B. Fleddermann, —Engineering Ethic, Pearson Prentice Hall, New Jersey, 2004.

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REFERENCE BOOKS

1. Luke W. Galen "The Nonreligious: Understanding Secular People and Societies", Oxford University Press,2016.
2. Bullivant, Stephen; Lee, Lois, "Secularism: A Dictionary of Atheism", Oxford University Press, 2016.
3. Soumitro Banerjee, "Research Methodology for Natural Sciences", IISc Press, January 2022.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2014.
5. Laura P. Hartman and Joe Desjardins, —Business Ethics: Decision Making for Personal Integrity and Social Responsibility‖ Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	-	-	-	-	-	-	2	-	3	3	-	3	2	3
CO2	-	-	-	-	-	-	2	-	3	3	-	3	2	3
CO3	-	-	-	-	-	-	2	2	**3**	3	-	3	2	3
CO4	-	-	-	-	-	-	2	2	**3**	3	-	3	2	3
CO5	-	-	-	-	-	-	2	2	**3**	3	-	3	2	3
AVG	-	-	-	-	-	-	**2**	**2**	**3**	**3**	-	**3**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24BM7101 EMBEDDED SYSTEMS AND IoMT **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- To understand IoT architecture and Build simple IoT Systems using embedded target boards.
- To understand IoMT infrastructure for healthcare applications.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN **9**

Introduction to embedded processors- Application Areas- Categories of embedded processors- Challenges in Embedded System Design, Design Process- Requirements- Specifications- Hardware architecture- Software architecture-Introduction to Harvard & Von Neuman architectures- CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices, and their Characteristics- RAM, EEPROM-Flash Memory- DRAM. BIOS, POST, Device Drivers.

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UNIT II PERIPHERAL INTERFACING **9**

I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing- Memory interfacing with a case study- I/O Device Interfacing with case Study-Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth.

UNIT III EMBEDDED SYSTEM SOFTWARE DESIGN **9**

Application Software, System Software, Design techniques – State diagrams, sequence diagrams, flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages-embedded C / C++ Programming, Integrated Development Environment tools-Editor- Compiler- Linker- Automatic Code Generators- Debugger- Board Support Library-Chip Support Library, Analysis and Optimization-Execution Time- Energy & Power.

UNIT IV DESIGN AND DEVELOPMENT OF IOT **9**

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies.

UNIT V INTERNET OF MEDICAL THINGS (IoMT) **9**

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An loT Model for Neuro sensors, AdaBoost with feature selection using loT for somatic mutations evaluation in Cancer, A Fuzzy- Based expert System to diagnose Alzheimer's Disease, Secured architecture for loT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Write Basic and arithmetic Programs Using Embedded C.
2. Write Embedded C program to test interrupt and timers.
3. Develop Real time applications – clock generation, waveform generation, counter using embedded C.
4. Explore different communication methods with IoT devices.
5. To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.
6. To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.
7. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.
8. Develop IoMT Application using open platform/ Aurdino. /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.

CO2: Describe the hardware architecture and features of embedded microcontrollers and peripherals.

CO3: Explain software design tools and embedded system design programming phases.

CO4: Describe IoT Architectures and Build simple IoT Systems using embedded target boards.

CO5: Exhibit understanding of IoMT infrastructure for healthcare applications.

TEXT BOOKS

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

REFERENCE BOOKS

1. Shibu K V "Introduction to Embedded Systems," Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 00706787903.
2. David E.Simon, ,Addison Wesley, "Embedded Software Primer", ISBN-13: 978-0201615692.
3. Barry B.Brey, "The Intel Microprocessors, Architecture, Programming and Interfacing" , 6th Edition, Pearson Education.
4. Arshdeep Bahga, Vijay Madisetti, "lnternet of Things – A hands-on approach", Universities Press, 2015.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	-	-	-	-	-	-	3	-	-	-	1	-	-
CO2	1	-	-	-	-	-	-	3	-	-	-	1	-	-
CO3	1	-	-	-	-	-	-	3	-	-	-	1	-	-
CO4	1	-	1	-	-	-	-	3	-	-	-	1	-	-
CO5	1	-	-	-	-	-	-	3	-	-	-	1	-	-
AVG	1	-	1	-	-	-	-	3	-	-	-	1	-	-

1-Low, 2-Medium, 3-High, '-'- No Correlation

24BM7501 MINI PROJECT **L T P C**

0 0 4 2

COURSE OBJECTIVES

- Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
- Conducting experiments, analyze and discuss the test results, and make conclusions.
- Preparing project reports and presentation.

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

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Formulate a problem / create a new product/ process.
CO2: Analyze the identified problem.
CO3: Design and conduct experiments to find solution.
CO4: Analyze the results and provide solution for the identified problem.
CO5: Preparing of project report and presentation

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	2	3	1	-	1	3	2	2	1	1	1
CO2	2	2	2	2	3	1	-	1	3	2	2	1	1	1
CO3	2	2	2	2	3	1	-	1	3	2	2	1	1	1
CO4	2	2	2	2	3	1	-	1	3	2	2	1	1	1
CO5	2	2	2	2	3	1	-	1	3	2	2	1	1	1
AVG	**2**	**2**	**2**	**2**	**3**	**1**	**-**	**1**	**3**	**2**	**2**	**1**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24IS7201 INTERNSHIP **L T P C**

0 0 0 1

COURSE OBJECTIVES

- Students acquire practical knowledge through hands-on experience in an area of modern industries
- Gain real-world experience in the profession and enables correlation of classroom learning
- To experience the career development goals, involve in exploring the duties and qualifications of different careers.

COURSE DESCRIPTION

The purpose of the Internship Education Program is to provide each student practical experience in a standard work environment. An internship is an integral part of engineering education. It provides real-world experience in the profession; enables correlation of classroom learning with applications in industry; broadens understanding of the types of employment available in the field; helps the student discover individual interests; builds resume credentials; and develops relationships with industrial companies.

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.No.	Departments for 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	Biochemistry

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18	Paediatric/Neonatal
19	Dental
20	Oncology
21	PAC's
22	Medica lRecords / Telemetry

MONITORING OF INTERNSHIP

Documents required after the internship

1. Final report with full details of internship activities and contents learned during the entire period of internship.
2. Students shall maintain a day-to-day record of their engagement for the period of training. This will be recorded in an authorized diary to be counter signed by the concern authority at the each day and the same diary shall be submitted to the internship co-ordinator.
3. At the end of the training period, a student shall produce a certificate of satisfactory completion of training.

The final report should address the following:

- Projects and duties performed during the Internship.
- Learning that occurred as a result of the internship, in regard to
- The engineering profession.
- The particular industry.
- The organization/company.
- The technical skills developed.
- The individual interests and preferences discovered.
- Suggestions.
- Goals and plans regarding future professional development.

EVALUATION PROCEDURE

The weightage as follows

1. Internship final report : 30%
2. Authorized diary : 30%
3. Oral presentation through PPT : 40%

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Apply appropriate workplace behaviors in a professional setting.

CO2: Demonstrate content knowledge appropriate to job assignment.

CO3:Exhibit evidence of increased content knowledge gained through practical experience.

CO4:Evaluate the internship experience in terms of their personal, educational and career needs.

CO5:Refine and clarify professional and career goals through critical analysis of the internship experience.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO2	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO3	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO4	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO5	3	2	2	2	3	-	-	-	-	2	-	-	2	-
AVG	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24CA7201 CASE STUDY **L T P C**

0 0 0 1

COURSE OBJECTIVES

- To gain hands on industrial experience.
- To introduce industry problem solving skill.
- To familiarize the industrial operations.

The students should study at least two case studies during 6th Semester vacation and submit a details report not less than 20 pages with a copy of case study completion certificate from the Industry.

Part A: Case study on Industry Operation

The students should undergo case study on Industrial Operations.

- They should understand the company's structure, operational workflow, safety norms, and business model.
- Learn the specific department such as production, quality control, or logistics, total employees, turn-over and major tools and software etc are used by the industry.
- Students interact with industry experts, gather background information relevant to the industry.
- The students have to collect data, gather real-time processes, and analyze the challenges faced by the industry by using standard tools such as Fishbone diagrams, Pareto charts, or SWOT analysis.

Part B: Case study on Completed Project

The students should identify and select case study 2 as previously completed project relevant their domain.

- Students should follow the work flow structure such as interacting with team leader or manager, identify and understand the problem, collect relevant data, analyze roots & methodology are employed to complete the project and should understand the final outcome of the project.
- Students consolidate their findings and prepare a comprehensive report.

At the end of study,

The students should prepare a report not less than 20 pages and should include the copy of case study completion certificate in the report.

COURSE OUTCOMES

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

CO1: Explore the industry operations.

CO2: Analyze and interpret industrial data.

CO3: Apply engineering principles to industry real time problems.

CO4: Collaborate effectively with industry experts and teams.

CO5: Communicate technical information clearly and professionally.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	2	1	-	-	-	3	-	1	2	1
CO2	3	2	2	2	2	1	-	-	-	3	-	1	2	1
CO3	3	2	2	2	2	1	-	-	-	3	-	1	2	1
CO4	3	2	2	2	2	1	-	-	-	3	-	1	2	1
CO5	3	2	2	2	2	1	-	-	-	3	-	1	2	1
AVG	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**-**	**1**	**2**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

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24BM8501 PROJECT WORK **L T P C**

0 0 20 10

COURSE OBJECTIVES

- Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
- Conducting experiments, analyze and discuss the test results, and make conclusions
- Preparing project reports and presentation

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

TOTAL: 300 PERIODS

COURSE OUTCOMES

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

CO1: Formulate a problem / create a new product/ process.

CO2: Analyze the identified problem.

CO3: Design and conduct experiments to find solution.

CO4: Analyze the results and provide solution for the identified problem.

CO5: Preparing of project report and presentation

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	3	3	1	-	1	3	2	2	1	1	1
CO2	2	2	3	3	3	1	-	1	3	2	2	1	1	1
CO3	2	2	3	3	3	1	-	1	3	2	2	1	1	1
CO4	2	2	3	3	3	1	-	1	3	2	2	1	1	1
CO5	2	2	3	3	3	1	-	1	3	2	2	1	1	1
AVG	**2**	**2**	**3**	**3**	**3**	**1**	**-**	**1**	**3**	**2**	**2**	**1**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24BMPE01 MEDICAL OPTICS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To learn the optical properties of the tissues and the interactions of light with tissues.
- To know the medical Lasers and their applications.
- To understand the 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

COURSE OUTCOMES

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

CO1: Demonstrate knowledge of the fundamentals of optical properties of tissues.

CO2: Analyze the components of instrumentation in Medical Photonics and Configurations.

CO3: Describe surgical applications of lasers.

CO4: Describe photonics and its diagnostic applications.

CO5: Investigate emerging techniques in medical optics.

TEXT BOOKS

1. Tuan Vo Dirh, "Biomedical Photonics – Handbook", CRC Press, Bocaraton, 2014.
2. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and Sons, Inc. Publications, 2003.
3. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic press Inc. Year. 2012.

REFERENCE BOOKS

1. Markolf H.Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. G.David Baxter "Therapeutic Lasers – Theory and practice", Churchill Livingstone publications , 2001.
3. Leon Goldman, M.D., & R.James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., 1975.
4. John Crisp," Introduction to fiber optics", 2nd Edition, 2001, Newnes.
5. Lasers and Current Optical Techniques in Biology, Royal Society of Chemistry, 2004.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	2	1	3	3	-	-	-	2	-	3	2	-
CO2	3	-	2	1	3	3	-	-	-	2	-	3	2	-
CO3	3	-	2	1	3	3	-	-	-	2	-	3	2	-
CO4	3	-	2	1	3	3	-	-	-	2	-	3	2	-
CO5	3	-	2	1	3	3	-	-	-	2	-	3	2	-
AVG	**3**	**-**	**2**	**1**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**3**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE02 LASERS IN MEDICINE **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the knowledge of different laser techniques used in medicine and also know the photonics instrumentation.
- To be familiar with fiber optics property of tissues and be exposed to optical.
- To be familiar with fiber optics lasers in clinical applications.

UNIT I BASICS OF LASER **9**

Introduction to Lasers-Fundamental principles of laser operation, - Interaction of light and matter, population inversion, components of a laser system. Types of Lasers, Optical fibers fundamentals, Light transmission in optical fibers principles, Properties of optical fibers, Applications of Lasers.

UNIT II LASERS IN THERAPY, DIAGNOSIS &SINGLE OPTICAL FIBERS **9**

Laser assisted diagnosis and therapy, Interaction of laser beams and materials - principles laser interaction with tissue; Laser assisted diagnostics - principles, applications of lasers in diagnosis and imaging, advances; Laser surgery and therapy - principles photo, thermal and photo mechanical mechanisms; Thermal interaction between laser and tissue

UNIT III OPTICAL FIBER BUNDLES **9**

Non-ordered fiber-optic bundles for light guides fundamentals and principles; Ordered fiber optic bundles for imaging devices - fundamentals and principles, fiber scopes and endoscopes fundamentals; Fiber optic imaging systems - advances.

UNIT IV ENDOSCOPY **9**

Endoscopic imaging systems - fundamentals, principles, advances; Endoscopic diagnostics - advances, endoscopic therapy fundamentals; Endoscopic ultrasound imaging - principles.

UNIT V CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS **9**

Fiber optic laser systems in cardiovascular disease, Gastroenterology, Gynecology, Neurosurgery, Oncology, Ophthalmology, Orthopedics, Otolaryngology (ENT), Urology, Flow diagram for laser angioplasty and Photo dynamic therapy.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Categorize the properties and principles of light propagation in Optical fiber system.

CO2: Apply the endoscopic ultrasound imaging system.

CO3: Analyze the applications of Laser in Therapy and diagnosis.

CO4: Determine the clinical applications of fiber optic system such as cardiovascular disease, ENT and gastroenterology etc.

CO5: Evaluate the optical fiber bundles in medical endoscope applications.

TEXT BOOKS

1. Daniele Tosi, Guido Perrone, "Fiber-Optic Sensors for Biomedical Applications", Adam Hilgar Brustol Inc, 2017.
2. Andrew Motes, "A Student's Guide to Fiber Lasers", 1st edition Gordon Breach, Science Publishers Inc., 2014.
3. D.R. Vij (Editor), K. Mahesh (Editor)"Medical Applications of Lasers" Springer; 2002, 2nd edition.

REFERENCE BOOKS

1. Zujie Fang, Ken Chin, Ronghui Qu, Haiwen Cai, "Fundamentals of Optical Fiber Sensors", 1st Edition, WILEY, 2012.
2. Daniele Tosi, Guido Perrone, "Fiber-Optic Sensors for Biomedical Applications", Adam Hilgar Brustol Inc, 2017.
3. Abraham Katzir, "Lasers and Optical Fibers in Medicine", 1st edition, Elsevier, 2012.
4. Daniel S.J. Choy (Author),"**P**ercutaneous Laser Disc Decompression: A Practical Guide",Springer-Verlag New York Inc.; 3rd edition (3 November 2003).
5. Ronald W. Waynant , "Lasers in Medicine" ,Published December 20, 2001 by CRC Press.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	-	2	-	-	-	-	2	1	-	1	2	-
CO2	3	1	-	2	-	-	-	-	2	1	-	1	2	-
CO3	3	1	-	2	-	-	-	-	2	1	-	1	2	-
CO4	3	1	-	2	-	-	-	-	2	1	-	1	2	-
CO5	3	1	-	2	-	-	-	-	2	1	-	1	2	-
AVG	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE03 GENETIC ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To discuss the gene cloning methods and the tools and techniques involved in genecloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts.
- To acquire ability of function on multi-disciplinary teams.

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.

UNITIII SEQUENCING AND AMPLIFICATION OF DNA **9**

Maxam Gilbert's and Sanger's methods of DNA sequencing – PCR: Inverse PCR, Nested PCR, Allele specific PCR, Hot start PCR, Colony PCR, single cell PCR, Real- time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES **9**

Organization and structure of genomes - Genome sequencing methods: Conventional and shotgun genome sequencing methods, Next generation sequencing technologies - Ordering the genome sequence - Genetic maps and Physical maps, STS content based mapping, Hybridization mapping, Optical mapping.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS **9**

Introduction to Functional genomics – Microarrays - Serial Analysis of Gene expression (SAGE), Subtractive hybridization, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explain the fundamental principles and tools of recombinant DNA technology, including restriction enzymes, cloning vectors, and transformation methods.

CO2: Construct and evaluate genomic and cDNA libraries, and apply knowledge of artificial chromosomes and chromosomal walking techniques.

CO3: Compare and apply various DNA sequencing and PCR techniques, including real-time PCR and site-directed mutagenesis, for genetic analysis.

CO4: Describe genome organization and analyze different genome sequencing strategies, including next-generation sequencing and mapping techniques.

CO5: Interpret current trends in genome sequencing projects, functional genomics, and utilize bioinformatics tools and genomic databases for comparative and proteogenomic studies.

TEXT BOOKS

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", Blackwell Science Publications, 1993.
2. S.B.Primrose and R.M.Twyman,, " Principles of Genome Analysis and Genomics" by 3rd Ed. (Blackwell Publishing).
3. Smita Rastogi,Neelam Pathak , "Genetic Engineering (Oxford Higher Education)", Oxford University Press (8 July 2009).

REFERENCE BOOKS

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.
4. Setlow J.K., "Genetic Engineering Principles And Methods Vol 27 (Hb 2005)" Spinger 2005.
5. Daniel Hartl, 'Genetics: Principles and Analysis', Fourth Edition, Quiwan International University.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	2	1	-	-	3	1	-	-	-	3	2	1
CO2	3	-	2	1	-	-	3	1	-	-	-	3	2	1
CO3	3	-	2	1	-	-	3	1	-	-	-	3	2	1
CO4	3	-	2	1	-	-	3	1	-	-	-	3	2	1
CO5	3	-	2	1	-	-	3	1	-	-	-	3	2	1
AVG	**3**	**-**	**2**	**1**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**3**	**2**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE04 TISSUE ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To study the cell types and differentiation.
- To study basics about stem cells and its applications.
- To understand the methods and design involved in tissue engineering.

UNIT I INTRODUCTION 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 – Cell analysis techniques

UNIT II FUNDAMENTALS OF TISSUE ENGINEERING **9**

History and scope of tissue engineering - Tissue organization - Tissue types: Epithelial, Connective - Vascularity and angiogenesis - Wound healing - Extra Cellular Matrix: Matrix molecules and their ligands - Tissue culture – Materials in tissue engineering.

UNIT III STEM CELLS **9**

Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells-Cancer stem cells - Induced pleuripotent stem cells – Stem cell characterization techniques – Principle.

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

COURSE OUTCOMES

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

CO1: Explain the basic concepts of tissue engineering.

CO2: Acquire knowledge on tissue engineering.

CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies.

CO4: Design and develop different biomaterial in tissue engineering application.

CO5: Gain knowledge in research or clinical application on tissue repair/ engineering.

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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.
3. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press inc New York, 2004.

REFERENCE BOOKS

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.
4. Joseph P. Vacanti, Tissue Engineering and Regenerative Medicine, Cold Spring Harbor Laboratory Press, 2017.
5. Masoud Mozafari, Farshid Sefat, Anthony Atala, Handbook of Tissue Engineering Scaffolds: Volume One, Elsevier Science, 2019.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	1	-	-	-	-	-	-	-	1	1	-
CO2	3	2	3	1	-	-	-	-	-	-	-	1	1	-
CO3	3	2	3	1	-	-	-	1	1	-	-	1	1	-
CO4	3	2	3	1	-	-	-	1	1	-	-	1	1	-
CO5	3	2	3	1	-	-	-	-	-	-	-	1	1	-
AVG	**3**	**2**	**3**	**1**	-	-	-	-	-	-	-	**1**	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE05 BIOMETRIC SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts of fingerprint, iris, face and speech recognition.
- To study the general principles of design of biometric systems and the underlying trade-offs.
- To introduce the knowledge on personal privacy and security implications of biometrics based identification technology and the issues realized.

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

COURSE OUTCOMES

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

CO1: Demonstrate the principles of biometric systems.
CO2: Develop fingerprint recognition technique.
CO3: Design face recognition and hand geometry system.
CO4: Design iris recognition system.
CO5: Develop speech recognition and multimodal biometric systems.

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.

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REFERENCE BOOKS

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.
4. Ruud M. Bolle et al, "Guide to Biometrics", Springer, USA, 2003.
5. Anil K. Jain, Arun Ross, and KarthikNandakumar, "Introduction to biometrcis", 2011.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	2	-	-	-	1	-	-	-	-	1	1
CO2	3	2	1	2	-	-	-	1	-	-	-	-	1	1
CO3	3	2	1	2	-	-	-	1	-	-	-	-	1	1
CO4	3	2	1	2	-	-	-	1	-	-	-	-	1	1
CO5	3	2	1	2	-	-	-	1	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE06 FORENSIC SCIENCE IN HEALTHCARE **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To know the history of the forensic sciences and its place in popular culture.
- To understand the different types of professionals involved in evaluating a crime scene and the collected evidence and forensic microscope and Anthropology.
- To learn the Blood stain identification and the methodology of collecting & interpreting data for fingerprint application.

UNIT I BASICS OF FORENSIC SCIENCE **9**

Forensic science, Introduction to the Forensic Sciences, History and Development of Forensic Science, Deductive Reasoning, Organization of a Crime Laboratory Case Studies: The Enrique Camarena Case. A Forensic Nightmare Organization of forensic science laboratories of center and state -NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions.

UNIT II OBSERVATION AND CRIME SCENE **9**

Observational Skills - Sherlock Holmes and Deductive Reasoning - Observations by Witnesses. Case Studies. The Crime Scene -Locard's Exchange Principle, Securing and Recording the Crime Scene, Legal Considerations at the Crime Scene, Evidence Collection and Recordation Techniques. Mock Crime Scene: Processing and Documenting a Crime Scene.

UNIT III FORENSIC MICROSCOPE AND ANTHROPOLOGY **9**

Forensic Use of the Microscope -The Compound, Comparison, and Stereoscopic Microscope, The Scanning Electron Microscope (SEM). Forensic Anthropology- Introduction, Human Anatomy–The Skeletal System, Skeletal Determination of Demographic Data from Skeletal Remains, Determining Types of Trauma and Disease from Skeletal Remains, Case Studies.

UNIT IV BLOOD STAIN IDENTIFICATION **9**

Detection and identification of Blood stains, Determination of species of origin, Blood Group systems, Techniques of Determination of Blood groups of Blood stains,Determination of seminal and other fluids and their Blood Grouping, DNA, DNA Phenotyping and RNA Profiling & their applications. Wildlife forensics.

UNIT V FINGERPRINT APPLICATION **9**

Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1: Define the significance of forensic sciences.
CO2: Observe and document crime scenes.
CO3: Determine Trauma and Diseases.
CO4: Describe the various sources of medical data related to forensic science.
CO5: Demonstrate the visual analytical procedure of finger print application.

TEXT BOOKS

1. Nanda, B.B. and Tewari, R.K. (2001), " Forensic Science in India: A vision for the twenty first century" Select Publisher, New Delhi.
2. James, S.H and Nordby, J.J. (2003) Forensic Science: "An introduction to scientific and investigative techniques", CRC Press.
3. K.S. Narayan Reddy,The Essentials of Forensic Medicine & Toxicology 35th Edition, Kindle Edition.

REFERENCE BOOKS

1. K Thangaraj,"Practical Forensic Medicine**"** (Paperback) | Released: 28 Feb 2016, Cbs publishers and distributors pvt. Ltd
2. Connie Darnell , **"**Forensic Science in Healthcare: Caring for Patients, Preserving the Evidence " – 18 April 2018, CRC Press
3. Rajesh Bardale, "Principles of Forensic Medicine & Toxicology" 4th Edition 2024, Jaypee Brothers Medical Publishers
4. Taylor & Francis , "Forensic Science in Healthcare Caring for patients preserving the evidence" (PB 2011) Paperback – Illustrated, 4 February 20.
5. BV Subrahmanyam, "Clinical Toxicology and Forensic Science" 1st Edition, CBS Publishers & Distributors

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO2	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO3	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO4	3	1	1	-	1	1	-	1	-	-	-	-	1	-
CO5	3	1	1	-	1	1	-	1	-	-	-	-	1	-
AVG	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE07 HEALTHCARE ANALYTICS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the statistical methods for the design of biomedical research and the Meta analysis and variance analysis.
- To comprehend the fundamental of mathematical and statistical theory in the application of Healthcare.
- To apply the regression and correlation analyze in the healthcare data and Interpret the results of the investigational methods.

UNIT I INTRODUCTION **9**

Introduction, Computers and bio statistical analysis, Introduction to probability, likelihood & odds, distribution variability. Finding the statistical distribution using appropriate software tool like R/ Python.

UNIT II STATISTICAL PARAMETERS **9**

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.

UNIT III REGRESSION AND CORRELATION ANALYSIS **9**

Regression model, evaluating the regression equation, correlation model, correlation coefficient. Finding regression, correlation for the data using appropriate software like R / Python.

UNIT IV ANALYSIS OF VARIANCE **9**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment. Testing the variance using appropriate software tool like R / Python.

UNIT V CASE STUDIES **9**

Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Define the new and existing statistical methodology for their research problem.
CO2: Explain p- values for different statistical test.
CO3: Analyze the biomedical research data and able to report the study results.
CO4: Enumerate the Meta analysis and variance analysis.
CO5: Describe problems of human health and disease for the interest of advancing the public's Health.

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 ISBN:978- 1-305-26892-0.

REFERENCE BOOKS

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.
4. "Essentials of Healthcare Analytics" (Paperback) | Released: 13 Aug 2024
5. Kumar Vikas, "Healthcare Analytics Made Simple"| Publisher: Notion Press Media Pvt. Ltd.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO2	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO3	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO4	3	3	1	1	1	-	-	-	-	-	-	1	1	1
CO5	3	3	1	1	1	-	-	-	-	-	-	1	1	1
AVG	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1--Low, 2-Medium, 3-High, "-" – No correlation

24BMPE08 VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues.
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications and the intricacies of these platform to develop PDA applications with better optimality.
- To learn the various applications of VR and implementing target-specific VR applications on mobile.

UNIT I INTRODUCTION **9**

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation- interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT II VR DEVELOPMENT PROCESS **9**

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling- model management.

UNIT III CONTENT CREATION CONSIDERATIONS **9**

Methodology and terminology-user performance studies-VR health and safety issues- Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment.

UNIT IV VR ON THE WEB & VR ON THE MOBILE **9**

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT V APPLICATIONS **9**

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Analyze and Design a system or process to meet given specifications with realistic engineering constraints.

CO2: Identify problem statements and function as a member of an engineering design team.

CO3: Analyze the implications and issues pertaining to VR.

CO4: Apply web and mobile-based VR frameworks and tools to develop interactive VR experiences, incorporating spatial audio, haptics, and user interaction techniques.

CO5: Develop simple and portable VR applications using appropriate software.

TEXT BOOKS

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Jason Jerald, The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, 2015.
3. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575.

REFERENCE BOOKS

1. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1st edition, 2016.
2. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1st edition, 2016.
3. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1st edition, 2015.
4. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1st edition, 2014.
5. 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

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE09 BIOTELEMETRY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the Fundamentals of Telemetry Systems.
- To know the importance of Radio Telemetry system.
- To know the importance of optical telemetry System.

UNIT I FUNDAMENTALS OF TELEMETRY SYSTEMS **9**

Fundamental concepts–Significance, Principle, functional blocks of Telemetry and Tele control system-Methods of telemetry – Electrical, Pneumatic, Hydraulic and Optical Telemetry – State of the art-Telemetry standards, Ambulance telemetry.

UNIT II TYPES OF TELEMETRY SYSTEMS **9**

Electrical Telemetry-Current Systems – Voltage Systems – Synchro Systems – Frequency systems – Position and Pulse systems – Example of a landline telemetry system.

UNIT III RADIO TELEMETRY SYSTEM **9**

Block diagram of a Radio Telemetry system – Transmitting and receiving techniques – AM, FM, PM, Multiplexing and demultiplexing – Transmitting and receiving techniques – Digital coding methods – Advantages of PCM, PWM, PM, FSK – Delta modulation–coding and decoding equipment–Example of a radio telemetry system.

UNIT IV OPTICAL TELEMETRY SYSTEM **9**

Optical fibers for signal transmission – Sources for fiber optic transmission –Optical detectors– trends in fiber–optic device development–Example of an optical telemetry System.

UNIT V TELE COMMUNICATIONS FOR HEALTH CARE **9**

Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super specialty centers, Societal medico legal aspects, Networking (local, national & global).

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore biotelemetry principles.
CO2: Apply biotelemetry in diagnostics.
CO3: Grasp Radio Telemetry concepts.
CO4: Explore Optical Telemetry Systems.
CO5: Implement Telecommunication in Healthcare.

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TEXT BOOKS

1. D.Patranabis, Telemetry principles, Tata Mcgraw Hill Publishers.
2. Marilyn J.Field ,Tele medicine: A Guide to Assessing Telecommunications for Health Care, National Academic Press, 1996 (UNIT V).
3. Wootton,R.,Craig,J.,Patterson,V.(Eds.),"Introduction to Tele medicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006.

REFERENCE BOOKS

1. Charles J. Amlaner (Author), David W. Macdonald (Author), A Handbook on Biotelemetry and Radio Tracking, Pergamon Press; 1st edition (January 1, 1980).
2. Konstantina S. Nikita, "Handbook of Biomedical Telemetry", Wiley -IEEE Press, ISBN: 9781118388617.
3. Frank Carden, " Telemetry Systems Engineering", Artech House, 2002.
4. David Bailey, "Practical Radio Engineering and Telemetry for Industry", Newnes (an imprint of Elsevier), 2003.
5. Clive L. Dym and Patrick Little, "Design and Construction of an Optical Telemetry System", Harvey Mudd College, 2006.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	2	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	2	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	2	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	2	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	2	2	1	1	2	-	-	1	-	-	-	-	1	1

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE10 BODY AREA NETWORKS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To know the hardware requirement of BAN.
- To understand the communication and security aspects in the BAN.
- To know the applications of BAN in the field of medicine.

UNIT I INTRODUCTION **9**

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT II HARDWARE FOR BAN **9**

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN **9**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the basics of Body Area Networks and its architecture.
CO2: Design a BAN for appropriate application in medicine.
CO3: Assess the efficiency of communication and the security parameters.
CO4: Explain the need for medical device regulation and regulations followed in various regions.
CO5: Extend the concepts of BAN for medical applications.

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.
3. Guang-ZhongYang(Ed.),"Body Sensor Networks," Springer, 2006.

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REFERENCE BOOKS

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
2. Guang-ZhongYang (Ed.), "Body Sensor Networks'', Springer, 2006.
3. Annalisa Bonfiglio, Danilo DeRossi, "Wearable Monitoring Systems", Springer, 2011.
4. AndreasLymberis,DanilodeRossi, 'Wearable Health systems for Personalized Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004.
5. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
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CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
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CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE11 COMMUNICATION SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the various analog and digital modulation techniques.
- To study the principles behind various error control coding.
- To study the various digital communication techniques.

UNIT I ANALOG MODULATION **9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – Angle modulation –PM and FM– Modulators and Demodulators.

UNIT II RECEIVER CHARACTERISTICS **9**

Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems – Single tuned receivers – Super heterodyne receivers.

UNIT III INFORMATION THEORY **9**

Measure of information – Entropy – Source coding theorem – Discrete memory less channels – lossless, deterministic, noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon- Fano coding, Huffman Coding, run length coding, LZW algorithm.

UNIT IV BANDPASS SIGNALING **9**

Geometric representation of signals – Correlator and matched filter – ML detection – generation and detection, PSD, BER of coherent BPSK, BFSK, QPSK –Principles of QAM– Structure of non- coherent receivers – BFSK, DPSK.

UNIT V ERROR CONTROL CODING TECHNIQUES **9**

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes (CRC) – Convolutional codes – Viterbi decoding (Soft/Hard decision decoding).

TOTAL: 45 PERIODS.

COURSE OUTCOMES

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

CO1: Explain the concepts of analog modulation techniques.

CO2: Explore receiver characteristics.

CO3: Explain information theory and its coding techniques.

CO4: Apply digital modulation techniques.

CO5: Analyze various error control coding techniques.

TEXT BOOKS

1. B.P.Lathi, "Modern Digital and Analog Communication Systems'', Oxford University Press, 3rd Edition, 2007.
2. HTaub, DLSchilling, GSaha, "Principles of Communication Systems", TMH, 3rd Edition, 2007.
3. S.Haykin, "Digital Communications",JohnWiley,2005.

REFERENCE BOOKS

1. HPH su,Schaum "Outline Series, Analog and Digital Communications", TMH, 2006.
2. B.Sklar, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition, 2007.
3. J.G. Proakis, M. Salehi, "Fundamentals of Communication Systems", Pearson Education 2006.
4. D.Roody.J. Coolen, "Electronic Communications", PHI, 4th Edition, 2006.
5. V. Chandra Sekar, "Analog Communication", Oxford University Press, 2012.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
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CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	1
AVG	3	2	1	1	-	-	-	-	-	-	-	-	-	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE12 WEARABLE DEVICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the hardware requirement of wearable systems.
- To understand the communication and security aspects in the wearable devices.
- To know the applications of wearable devices in the field of medicine.

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force 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, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile.
CO5: Compare the various wearable devices in health care system.

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TEXT BOOKS

1. Annalisa Bonfiglo and Danilo DeRossi, Wearable Monitoring Systems, Springer, 2011.
2. Zhangand Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.
3. Edward Sazonov and Micheal R.Neuman,Wearable Sensors Fundamentals, Implementation and Applications, Elsevier, 2014.

REFERENCE BOOKS

1. Sandeep K.S,Gupta, Tridib Mukherjee and Krishna Kumar Venkata Subramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-ZhongYang, Body Sensor Networks, Springer, 2006.
3. Mehmet R. Yuce and Jamil Y.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.
4. Albert M.Cook and WebsterJ.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey,1982.
5. Andreas Lymberis, Danilode Rossi, 'Wearable Health systems for Personalized Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE13 ASSISTIVE TECHNOLOGY **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To know the hardware requirement various assistive devices.
- To understand the prosthetic and orthotic devices.
- To know the developments in assistive technology.

UNIT I CARDIAC ASSIST DEVICES **9**

Principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II HEMODIALYSERS **9**

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS **9**

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES **9**

Hand and arm replacement–different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, 3D Printing for Customized Devices, Brain-Computer Interfaces (BCIs), Robotics & Exoskeletons, Artificial Intelligence & Machine Learning in AT.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.

CO2: Describe the underlying principles of hemodialyzer machine.

CO3: Indicate the methodologies to assess the hearing loss.

CO4: Evaluate the types of assistive devices for mobilization.

CO5: Explain about TENS and bio feedback system.

TEXT BOOKS

1. Joseph D.Bronzino, The Biomedical Engineering Hand book, Third Edition: Three Volume Set, CRC Press,2006.
2. Marion.A.Hersh, Michael A. Johnson, Assistive Technology for visually impaired and blind, Springer Science & Business Media, 1st edition, 12-May-2010.
3. Yadin David, WolfW. VonMaltzahn, Michael R.Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition, 2010.

REFERENCE BOOKS

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. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019ISBN978-0-323- 662116.
4. Cardiac Assist Devices, Daniel Goldstein (Editor), MehmetOz (Editor),Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1.
5. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	1	1	-	-	-	-	-	-	-	2	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	2	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	2	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	2	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	2	-
AVG	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE14 ARTIFICIAL ORGANS AND IMPLANTS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To have an overview of artificial organs & transplants.
- To describe the principles of implant design with a case study.
- To explain the implant design parameters and solution in use.

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**

Bio compatibility, 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

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COURSE OUTCOMES

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

CO1: Gain adequate knowledge about artificial organs & transplants.

CO2: Get clear idea about implant design and its parameters and solution.

CO3: Have in-depth knowledge about blood interfacing implants.

CO4: Explain different types of soft tissue replacement and hard tissue replacement.

CO5: Assess compatibility and functioning of artificial organs inside the living system.

TEXTBOOK

1. KopffW.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976.
2. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.
3. Jonathan Black, Biological Performance of materials, Fundamentals of Bio compatibility, Marcel Dekker Inc., 4th edition New York, 2005.

REFERENCE BOOKS

1. JD Bronzino, Biomedical Engineering handbook Volume II,(CRC Press/ IEEE Press),2000.
2. RS Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.
3. Yannas,I.V," Tissue and Organ Regeneration in Adults ", NewYork, NY:Springer, 2001. ISBN:9780387952147.
4. John Enderle,Joseph D.Bronzino, Susan M.Blanchard," Introduction to Biomedical Engineering", Elsevier, 2005.
5. Joon Park, R S Lakes, Biomaterials: An Introduction, Springer science and Business Media, 2007.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	1	1	-	-	-	-	-	-	1	2	-
AVG	3	3	1	1	1	-	-	-	-	-	-	1	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE15 CRITICAL CARE EQUIPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To offer clear understanding of various intensive care equipment and their working.
- To understand the necessity of different operation theatre equipment.
- To know about different dialyzers and ventilators.

UNIT I INTENSIVE CARE UNIT EQUIPMENT **9**

Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer.

UNIT II CRITICAL CARE EQUIPMENT **9**

Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators, Intensive cardiac care.

UNIT III OPERATION THEATRE EQUIPMENT **9**

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyle's apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope, Tele-surgery.

UNIT IV CENTRALISED SYSTEMS **9**

Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.

UNIT V PATIENT SAFETY **9**

Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Apply the knowledge acquired, in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations.

CO2: Suggest suitable surgical instruments and operational devices.

CO3: Compare the various techniques for clinical diagnosis, therapy and surgery, and its recent methods.

CO4: Assess the merits of the operation theatre equipment based on its applications.

CO5: Design the devices for the particular application based on given specifications**.**

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J.Carr and John M.Brown,"Introduction to Biomedical Equipment Technology" Pearson education, 2012.
3. Khandpur.R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata McGraw-Hill Pub. Co.,Ltd. 2003.

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REFERENCE BOOKS

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
4. Baha Al-Shaikh & Simon G. Stacey, "Essentials of Equipment in Anaesthesia, Critical Care and Perioperative Medicine, Elsevier, 6th Edition (2023).
5. Paul L. Marino, "Marino's The ICU Book, Lippincott Williams & Wilkins, 5th Edition (2025).

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	2	-
AVG	3	2	1	1	1	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BMPE16 PRINCIPLES OF RADIOLOGICAL EQUIPMENT **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To understand the generation of X-ray and its uses in Medical imaging.
- To describe the principle of Computed Tomography.
- To learn the principles of different radio diagnostic equipment in Imaging and radiation therapy techniques and radiation safety.

UNIT I X- RAYS **9**

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X- Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT II COMPUTED TOMOGRAPHY **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT III MAGNETIC RESONANCE IMAGING **9**

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR IMAGING **9**

Radio isotopes - alpha, beta and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT V RADIATION THERAPY AND RADIATION SAFETY **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe the working principle of the X-ray machine and its application.

CO2: Illustrate the principle computed tomography.

CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.

CO4: Demonstrate the applications of radio nuclide imaging.

CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

TEXT BOOKS

1. Isaac Bankman,I.N.Bankman, Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000.
2. JacobBeutel (Editor), M.Sonka(Editor), Handbook of Medical Imaging,Volume 2, Medical Image Processing and Analysis , SPIE Press 2000.
3. KhinWeeLai, Dyah Ekashanti Octorina Dewi, " Medical Imaging Technology", Springer Singapore, 2015.

REFERENCE BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw–Hill, New Delhi, 2003.
2. Dougherty, Geoff(Ed.),"Medical Image Processing-Techniques and Applications", Springer-Verlag New York, 2011.
3. Andreas Maier, Stefan Steidl, Vincent Christlein, Joachim Hornegger, "Medical Imaging Systems: An Introductory Guide", Springer (2018).
4. Paul Suetens, "Fundamentals of Medical Imaging", Cambridge University Press (3rd Edition, 2009).
5. Troy Farncombe, Kris Iniewski, "Medical Imaging: Technology and Applications", CRC Press (2013).

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	2	-	-	-	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE17 REHABILITATION ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the sensory rehabilitation systems and virtual reality in rehabilitation.
- To learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- To have an understanding of rehabilitation medicine and advocacy.

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UNIT I INTRODUCTION TO REHABILITATION **9**

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

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

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

UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS 9

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

UNIT IV VIRTUAL REALITY 9

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

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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

TEXTBOOKS

1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press, 2000.
2. Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006.
3. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.

REFERENCE BOOKS

1. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
2. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
3. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis, 1988.
4. Keswick. J., "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation", Springer Verlag, New York, 1982.
5. Warren E. Finn, Peter G. Lopressor, "Handbook of Neuroprosthetic Methods",CRC, 2002.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO2	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO3	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO4	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO5	3	1	1	-	-	1	-	1	-	-	-	-	1	-
AVG	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE18 HUMAN ASSIST DEVICES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To study the role and importance of machines that takes over the functions of the heart, lungs and kidney.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications.

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UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART **9**

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT II CARDIAC ASSIST DEVICES **9**

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT III ARTIFICIAL KIDNEY **9**

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS **9**

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT VRECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the principles and construction of artificial heart.

CO2: Explore the various mechanical techniques that improve therapeutic technology.

CO3: Explain the functioning of the membrane or filter that cleanses the blood.

CO4: Describe the tests to assess the hearing loss and development of wearable devices for the same.

CO5: Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

TEXTBOOKS

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.

REFERENCE BOOKS

1. Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering" Marcel Dekker Inc New York 2004.
3. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.
4. Albert M.Cooka nd WebsterJ.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey,1982.
5. KolffW.J., Artificial Organs, John Wiley and Sons, NewYork, 1979.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
AVG	3	2	1	1	-	-	-	-	-	-	-	-	1	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE19 PATIENT SAFETY, STANDARDS AND ETHICS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the importance of patient safety against electrical hazards and standards and testing of patient.
- To explain the patient safety laws and regulations.
- To know the patient safety specialities in clinical and health care organization.

UNIT I EFFECTS OF ELECTRICITY **9**

Physiological effects of electricity - important susceptibility parameters - micro shock – macro shock hazards -patients electrical environment - isolated power system - conductive surfaces.

UNIT II PATIENT SAFETY LAWS AND REGULATIONS **9**

Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety Legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse-Event Reporting, Patient safety Goals and standards, The Quality Assessment and performance Improvement rule.

UNIT III STANDARDS AND TESTING **9**

Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyzer - Testing the electric system.

UNIT IV PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES **9**

Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.

UNIT V MEDICAL ETHICS **9**

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.

TOTAL: 45PERIODS

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COURSE OUTCOMES

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

CO1: Outline the importance of patient safety against electrical hazards.
CO2: Brief out the patient safety laws and regulations.
CO3: Explain the standards and testing of patient.
CO4: Explore the concept of the patient safety in clinical specialties.
CO5: Know about various health care organization.

TEXT BOOKS

1. JohnG. Webster,"MedicalInstrumentationApplicationanddesign",4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Liam Donaldson, Walter Ricciardi, "Textbook of patient safety and clinical Risk management", Springer.
3. FayA.Rozovsky, James R.Woods,Jr, "The Hand book of Patient Safety Compliance", 2016.

REFERENCE BOOKS

1. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012.
2. John D. Banja, " Patient Safety Ethics" Johns Hopkins University Press, 2019.
3. Bill Rumciman, Allan Merry, Merriyln Walton, "Safety and Ethics in Healthcare", Taylor & Francis Ltd, ISBN: 9780754644354.
4. Karen Judson, Carlene Harrison and Tammy Albright, " Law & Ethics for Health Professions", 10th Edition , ISBN10: 1266292950 | ISBN13: 9781266292958.
5. Seeram Ramakrishna, Lingling Tian, Charlene Wang, Susan Liao, Wee Eong Teo, Medical Devices Regulations, Standards and Practice, Wood head Publishing, 1st Edition, 2015.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	1	-	-	2	-	1	-	1	1	-
CO2	3	2	1	1	1	-	-	2	-	1	-	1	1	-
CO3	3	2	1	1	1	-	-	2	-	1	-	1	1	-
CO4	3	2	1	1	1	-	-	2	-	1	-	1	1	-
CO5	3	2	1	1	1	-	-	2	-	1	-	1	1	-
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**1**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BMPE20 ERGONOMICS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To get exposed to principles of visual capabilities and mechanics of muscle physiology and significance of rest cycle.
- To learn spatial compatibility and the relation between control orders and control response.
- To know about the measurements and proportions of the human body.

UNIT I VISUAL AND AUDITORY ERGONOMICS **9**

Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.

UNIT II MUSCLE PHYSIOLOGY **9**

Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT III CONTROLS AND DISPLAYS **9**

Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task.

UNIT IV ANTHROPOMETRY **9**

Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT V CASE STUDIES **9**

Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of this course, students will be able to

CO1: Explain the principles of ergonomics.
CO2: Explore the significance of posture.
CO3: Learn about tracking tasks.
CO4: Learn about ergonomics and its implications to various domain.
CO5: Perform case studies on electronic instruments and medical equipment.

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.

REFERENCE BOOKS

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.
4. Karl H E Kroemer, “Fitting the Human: Introduction to Ergonomics / Human Factors Engineering”, Seventh Edition, CRC Press.
5. Karl H. E. Kroemer, Hiltrud J. Kroemer, Katrin E. Kroemer-Elbert, “Engineering Physiology Bases of Human Factors Engineering/ Ergonomics”, Springer 2020.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	1	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	1	-
AVG	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE21 HOSPITAL PLANNING AND MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and simulations.
- To know the contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To understand the principles, practices and areas of application in Hospital management.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT III MARKETING RESEARCH & CONSUMER BEHAVIOUR **9**

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications..

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES **9**

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL **9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the principles, practices and areas of application in Hospital Management.

CO2: Explore the biomedical waste disposal concept.

CO3: Explain the importance of supportive services.

CO4: Comprehend the quality aspect specified by the international standards.

CO5: Acquire knowledge on hospital safety.

TEXTBOOKS

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI–4th Edition,2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management", TMH, New Delhi – 5th edition Reprint 2007.
3. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York,1977.

REFERENCE BOOKS

1. Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995.
2. Norman Metzger , "Handbook of Health Care Human Resources Management", Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990.
3. Arnold D. Kalcizony & Stephen M.Shortell, "Health Care Management", 6th Edition, 2011.
4. Blane, David, Brunner, Eric , "Health and Social organization: Towards a health policy for the 21st century", Calrendon Press, 1994.
5. Joydeep Das Gupta, "Hospital Administration and Management: A Comprehensive Guide", 2nd Edition 2018, ISBN: 9789352501328.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO2	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO3	3	2	1	-	-	1	-	1	-	1	-	-	-	-
CO4	3	2	1	-	-	1	-	1	-	1	1	-	-	-
CO5	3	2	1	-	-	1	-	1	-	1	1	-	-	-
AVG	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE22 MEDICAL WASTE MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the hazardous materials used in hospital.
- To know the impact of hazardous materials on health.
- To understand various waste disposal procedures and management.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS **9**

Healthcare hazard control : Introduction, hazard control, hazard control management, hazard control responsibilities, addressing behaviors, hazard control practice, understanding hazards, hazard analysis, hazard control and correction, personal protective equipment, hazard control committees, hazard control evaluation, hazards, system safety, ergonomics. Understanding accidents: accident causation theories, human factors, accident deviation models, accident reporting, accident investigations, accident analysis, organizational functions that support accident prevention, workers' compensation, orientation, education, and training.

contro

UNIT II BIOMEDICAL WASTE MANAGEMENT **9**

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III HAZARDOUS MATERIALS **9**

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT IV FACILITY SAFETY **9**

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY **9**

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

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Analyse various hazards, accidents and its control.
CO2: Design waste disposal procedures for different biowastes.
CO3: Categorise different biowastes based on its properties.
CO4: Design different safety facility in hospitals.
CO5: Propose various regulations and safety norms.

TEXT BOOKS

1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).
2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).
3. C.R. BRUNNER, Medical Waste Disposable Handbook, Incentrated, Consultant in Corporated, Virginia, 2000.

REFERENCE BOOKS

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.
2. V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991.
3. C.R. BRUNNER, Incentrated Consultant in Corporated Incentration System Hand Book, Virginia.
4. K.V. Ramani, Hospital Management : Text and Cases", 2013 1st edition, Pearson Education, New Delhi, India.
5. Sharon Bell Buchbinder, Nancy H. Shanks, "Introduction to Health Care Management", Jones & Bartlett Publishers, Boston, USA.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	-	1	2	1	-	-	-	1	-	-
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CO3	3	2	1	-	-	1	2	1	-	-	-	1	-	-
CO4	3	2	1	-	-	1	2	1	-	-	-	1	-	-
CO5	3	2	1	-	-	1	2	1	-	-	-	1	-	-
AVG	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE23 MEDICAL INNOVATION AND ENTREPRENEURSHIP **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To learn fundamentals of entrepreneurship.
- To apply the methods of entrepreneurship in medical field.
- To evaluate the medical devices and market trends.

UNIT I CREATIVITY, INNOVATION AND IPR **9**

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

UNIT II SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP **9**

Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

UNIT III NEW VENTURE **9**

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications..

UNIT IV FINANCING THE NEW VENTURE AND GLOBALIZATION **9**

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT V MARKETING FUNCTION **9**

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe the role of biomedical engineers in entrepreneurship.

CO2: Interpret the background for biomedical engineers in entrepreneurship.

CO3: Acquire the skills and techniques required towards innovation.

CO4: Categorize the resources and funding agencies and judge the right product based on market needs.

CO5: Compile and quantify the opportunities and challenges.

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TEXTBOOKS

1. Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA. 2010.
2. Vasant Desai, —The Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 2010.
3. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016.

REFERENCE BOOKS

1. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014.
2. Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western.
3. Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012.
4. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review‖, TATA McGraw Hill, 2012.
5. Sudha G. S., "Management and Entrepreneurship Development", Indus Valley Publication, 2009.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	1	-	-	2	-	1	-	1	-	-
CO2	3	2	1	1	1	-	-	2	-	1	-	1	-	-
CO3	3	2	1	1	1	-	-	2	-	1	-	1	-	-
CO4	3	2	1	1	1	-	-	2	-	1	-	1	-	-
CO5	3	2	1	1	1	-	-	2	-	1	-	1	-	-
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE24 BIO MEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Learn various MEMS fabrication techniques.
- Understand different types of sensors and actuators and their principles of operation at the micro scale level.
- Know the application of MEMS in different field of medicine.

UNIT I MEMS MATERIALS AND FABRICATION **9**

Typical MEMs and Microsystems, materials for MEMS - active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS **9**

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor.

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS **9**

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS **9**

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers.

UNIT V APPLICATIONS OF BIOMEMS **9**

CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Summarize various MEMS fabrication techniques.

CO2: Elucidate different types of mechanical and thermal sensors and actuators and their principles of operation at the micro Scale level.

CO3: Describe different types of various electrostatic and piezoelectric sensors and actuators and their principles of operation at the micro Scale level.

CO4: Explain microfluidic systems.

CO5: Illustrate MEMS in different field of medicine.

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TEXTBOOKS

1. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. Wanjun Wang and Stephen A. Soper, "BioMEMS: Technologies and Applications", CRC Press, NewYork, 2007.
3. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2011.

REFERENCE BOOKS

1. Marc J. Madou "Fundamentals of Microfabrication: the Science of Miniaturization", CRC Press,2002.
2. Nadim Maluf, Kirt Williams. "An introduction to Microelectro Mechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
3. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007.
4. Alok Pandya ,Vijai Singh, "Micro/ Nanofluidics and Lab-on-Chip Based Emerging Technologies for Biomedical and Translational Research Applications - Part B", Academic Press, 2022.
5. Wanjun Wang, Steven A. Soper, "Bio-MEMS: Technologies and Applications" Kindle Edition CRC Press; 1st edition (15 December 2006).

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	2	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	2	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	2	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	2	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	2	-	-	-	-	-	-	-	1	-
AVG	3	2	1	1	2	-	-	-	-	-	-	-	1	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE25 SPEECH AND AUDIO SIGNAL PROCESSING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To introduce the basic knowledge about speech production and hearing.
- To understand time-frequency analysis concepts and domain methods for speech Processing.
- To learn fundamentals of audio coding and transform coders and linear predictive analysis of speech.

UNIT I MECHANICS OF SPEECH AND AUDIO **9**

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous 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, Audio Coding - 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.

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UNIT IV TIME AND FREQUENCY DOMAIN **9**

Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods **HOMOMORPHIC SPEECH ANALYSIS:** Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

UNIT V LINEAR PREDICTIVE ANALYSIS **9**

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

MATLAB tool based simulation experiments

1. Speech acquisition and recording.
2. Non-Stationary Nature of Speech Signal.
3. Identification of Voice/Unvoiced/Silence regions of Speech.
4. Short Term Time Domain Processing of Speech.

5. Fundamental frequency estimation in Speech signal.
6. Format synthesis MFCC extraction from Speech signal.
7. Linear Prediction Analysis.
8. LPCC extraction from Speech signal.

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Examine auditory models to design perceptual audio quality measure.
CO2: Design analysis-by-synthesis model for speech perception.
CO3: Analyze and design algorithms for speech and audio coding.
CO4: Analyze and design algorithms for extracting parameters from the speech signal.
CO5: Implement pitch detection and formant analysis in speech signals.

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.
3. Gold and Morgan,Speech and Audio Signal Processing , Wiley and sons, 2011.

REFERENCE BOOKS

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

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO5	3	2	1	1	-	-	-	-	-	-	-	-	1	1
AVG	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE26 MEDICAL DEVICE DESIGN **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand about basic design construction and development of medical devices.
- To follow a deterministic engineering design process to create new products.
- To perform design transfer and counter measure development.

UNIT I INTRODUCTION **9**

Needs finding, problem identification, prior art searches, strategy and concept generation, estimation, sketching, sketch modelling, machine elements, ergonomics and prototyping.

UNIT II DESIGN OF MEDICAL DEVICES & SYSTEM **9**

Medical device classification, bioethics, and privacy, biocompatibility and sterilization techniques, design of clinical , trials, design control and regulatory requirements, introduction to specific, medical technologies: biopotentials measurement (EMG, EOG, ECG, EEG), medical diagnostics (In-vitro diagnostics), medical diagnostics (Imaging), minimally invasive devices, surgical tools and implants.

UNIT III DEVELOPMENT STRATEGY AND PLANNING **9**

Intellectual property strategy – research and development strategy – clinical strategy – regulatory strategy – quality and process management – reimbursement strategy – marketing and stakeholder strategy – sales and distribution strategy – competitive advantage and business strategy.

UNIT IV HARDWARE AND SOFTWARE DESIGN **9**

Hardware design, Hardware risk analysis, Design and project merits, Design for six sigma, software design, software coding, software risk analysis, software metrics, licensing and alternate pathways.

UNIT V DESIGN TRANSFER AND IPR **9**

Transfer to manufacturing, documents and deliverables. Standard-ISO, IES, Intellectual Property - Patents, Copy rights, Trademarks, Trade secrets.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Simulation of over and under voltage protection circuit.
2. Simulation of instrumentation amplifier.
3. Accelerometer data acquisition and displaying system.
4. Multichannel data acquisition for EEG recording.
5. Simulation of switched capacitor system.
6. Modeling and simulation of internal noise cancellation circuit.
7. Cross talk cancellation system.
8. Serial and Parallel Interfacing to DSP.

TOTAL: 30 PERIODS

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COURSE OUTCOMES

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

CO1: Design and develop voltage protection circuits.

CO2: Develop data acquisition displaying system.

CO3: Attain knowledge in EEG multi channel acquisition method.

CO4: Design noise cancellation system.

CO5: Develop the interfacing mechanism using DSP.

TEXT BOOKS

1. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner- Bonneau, "Handbook of Human Factors in Medical Device Design", CRC press, 2010.
2. Peter J. Ogrodnik, "Medical Device Design: Innovation from Concept to Market", Academic Press Inc; 1st Edition, 2012.
3. Paul H. King, Richard C. Fries, Arthur T. Johnson, **"**Design of Biomedical Devices and Systems", Third Edition, 2014.

REFERENCE BOOKS

1. StefanosZenios , Josh Makower , Paul Yock , Todd J. Brinton , Uday N. Kumar , Lyn Denend, Thomas M. Krummel, "Biodesign: The Process of Innovating Medical Technologies",Cambridge University Press; 1st edition, 2009.
2. Zenios, Makower and Yock, —Biodesign – The process of innovating medical technologies‖, Canbridge University Press, 2009.
3. Theodore R. Kucklick , The Medical Device R&D Handbook, Second Edition, CRC Press, 2012.
4. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design,2nd edition, 2005.
5. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	1	-	-	-	-	1	-	1	-	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	-	-
CO3	3	2	1	1	1	-	-	1	1	1	-	1	-	-
CO4	3	2	1	1	1	-	-	1	1	1	-	1	-	-
CO5	3	2	1	1	1	-	-	1	1	1	-	1	-	-
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BMPE27 TELEHEALTH TECHNOLOGY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To Learn the key principles for telemedicine and health.
- To Understand telemedical technology.
- To Know telemedical standards, mobile telemedicine and it applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE **9**

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE **9**

Audio, video, still images, text and data, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE **9**

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment – data protection & security, jurisdictional issues.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM **9**

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE **9**

Tele radiology, tele pathology, tele cardiology, tele oncology, tele dermatology, tele surgery.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Port sensor data on mobile device using suitable communication protocol.
2. Use IoT for healthcare monitoring.
3. Study on telemedicine tools.
4. Upload data in the cloud platform.
5. Design any mobile application to read and transmit wirelessly the heart rate.
6. Develop a telehealth application for patients.
7. Develop a telehealth application for healthcare providers.
8. Exploring telehealth platforms and applications.
9. Integrating wearable devices and sensors.

TOTAL: 30 PERIODS

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COURSE OUTCOMES

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

CO1: Analyze the benefits and limitations of telemedicine.

CO2: Apply multimedia technologies in telemedicine.

CO3: Explain protocols behind encryption techniques for secure transmission of data.

CO4: Develop radiology based information system.

CO5: Apply telemedicine in various healthcare domains.

TEXT BOOKS

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002
2. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
3. Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.

REFERENCE BOOKS

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

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	1	-	-	-	-	1	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	2	-
CO3	3	2	1	1	1	-	-	1	1	1	-	1	2	-
CO4	3	2	1	1	1	-	-	1	1	1	-	1	2	-
CO5	3	2	1	1	1	-	-	1	1	1	-	1	2	-
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE28 CLINICAL ENGINEERING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations.
- To practice medical equipment and analyze challenges with their healthcare technology.
- To explore the Health Technology Management systems with medical devices and supportive services with advanced application.

UNIT I INTRODUCTION **9**

Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT II MEDICAL TECHNOLOGY MANAGEMENT PRACTICES **9**

Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT III ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP) **9**

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.

UNIT IV CLINICAL ENGINEERING PROGRAM INDICATOR **9**

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process, Auto Analyzer.

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.

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS

1. Quantitative estimation of PH values.
2. Analysis of Chromatography of amino acids.
3. Colorimetric & Spectrophotometric determination of biomolecules.
4. Analysis of Plasma protein electrophoresis.
5. Quantitative estimation of Glucose.
6. Quantitative estimation of Urea.
7. Identification of ketone bodies.
8. Estimation of cholestrol in serum - Lipid profile.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the basic concepts of medical and healthcare technology.

CO2: Explore the program and framework to recognize the errors in medical equipment.

CO3: Formulate patient safety package system.

CO4: Define the clinical problems precisely and examine the possible issues using program indicators.

CO5: 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, 23-Dec- 2015 - Technology & Engineering.
3. Webster J.C. and Albert M.Cook, "Clinical Engineering Principle and Practice", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979.

REFERENCE BOOKS

1. William Charney, Handbook of Modern Hospital Safety, CRC press.
2. Gaw, "Clinical Biochemistry", 1st edition, Ellis Horwood Ltd, 2013.
3. DM. Vasudevan, Sreekumari S, Kannan Vaidyanathan, "Textbook of Biochemistry for Medical Students", 9th edition, Jaypee Brothers Medical Publications, 2019.
4. William J. Marshall, "Clinical Biochemistry: Metabolic and Clinical Aspects" Churchill Livingstone;3rd edition,2014.
5. Muzumdar A., "Powered Upper Limb Prostheses: Control, Implementation and Clinical Application", Springer, 2004.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	2	1	-	1	-	-	-	3	2	-
CO2	3	-	-	-	2	1	-	1	-	-	-	3	2	-
CO3	3	-	-	-	2	1	-	1	-	-	-	3	2	-
CO4	3	-	-	-	2	1	-	1	-	-	-	3	2	-
CO5	3	-	-	-	2	1	-	1	-	-	-	3	2	-
AVG	3	-	-	-	2	1	-	1	-	-	-	3	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE29 ADVANCEMENTS IN HEALTHCARE TECHNOLOGY **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the needs for wearable devices and the technology.
- To learn the concepts in digital health care and digital hospitals.
- To apply the tools in design, testing and developing digital health care equipment.

UNIT I DIGITAL HEALTH **9**

Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT II DIGITAL RADIOLOGY **9**

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT III E-HEALTH **9**

E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology, Design of central nursing station.

UNIT IV M-HEALTH CARE AND WEARABLE DEVICES **9**

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT V MODALITY AND STANDARDS FOR INTER-OPERABILITY **9**

Multimodality registration in daily clinical practice, Mobile healthcare, Selection and Implementation in e-Health project, design of medical equipment based on user needs, Security and privacy in digital health care, Case study.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Study of open source software.
2. Data storage and retrieval on software.
3. Creation of electronic patient record.
4. Web page creation using HTML.
5. Preprocessing the given dataset.
6. User interface design.
7. Univariate and Multivariate regression.
8. Classification techniques.

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Interpret the need for digital methods of handling medical records.

CO2: Explain the digital radiology.

CO3: Modify the tools and methods for work flow in E-Health.

CO4: Identify the available technology for wearable healthcare devices.

CO5: Compare various standards for inter-operability of devices, quality and safety standards for developing healthcare systems.

TEXT BOOKS

1. Christoph Thuemmler, Chunxue Bai, “Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare”, Springer, 1st ed. 2017.
2. Wlater Hruby, “Digital revolution in radiology – Bridging the future of healthcare, second edition, Springer, New York. 2006.
3. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, “Requirements Engineering For Digital Health”, Springer, 2015.

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REFERENCE BOOKS

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.
2. Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003.
3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013.
4. A.C Anand, J F Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Healthcare", 2nd edition, CRC, 2016.
5. Nguyen Thi Dieu Linh, Zhongyu, "Data Science and Medical Informatics in Healthcare Technologies", Springer, 2021.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	1	-	1	2	1	-	3	2	-
CO2	3	2	-	-	2	1	-	1	2	1	-	3	2	-
CO3	3	2	-	-	2	1	-	1	2	1	-	3	2	-
CO4	3	2	-	-	2	1	-	1	2	1	-	3	2	-
CO5	3	2	-	-	2	1	-	1	2	1	-	3	2	-
AVG	**3**	**2**	**-**	**-**	**2**	**1**	**-**	**1**	**2**	**1**	**-**	**3**	**2**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24BMPE30 MEDICAL INFORMATICS AND EXPERT SYSTEM **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To study the applications of information technology in health care management.
- To acquire knowledge on resources, devices, and methods to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.
- To understand the use of health informatic tools in medical informatics and expert systems.

UNIT I INTRODUCTION TO DATA STRUCTURES **9**

Introduction to data structures -Elements, arrays, records, sets, tables etc. Singly and doubly linked data, stacks, queues, trees etc. Introduction to database, data models, Relational, distributed and other types of databases, data indexing and structuring techniques: data independence, data definition language and data manipulation language. E -R diagram with examples. Relational model, structure of Relational databases, Query language, views, Examples.

UNIT II RELATIONAL DATABASE DESIGN **9**

Normalisation - 1NF, 2NF and 3NF. Indexing and Hashing. Security of databases. Design example on a popular RDBMS package. Miniaturized data storage and retrieval system like CD-ROM, Magneto Optical Discs, optical juke boxes, write many read many devices and miniature magnetic tape devices. Interfacing and retrieval details.

UNIT III EXPERT SYSTEMS **9**

Introduction - basic concepts - structure of expert systems - types of expert systems - knowledge engineering – methods & difficulties in knowledge acquisition – Search and real time search – constraint satisfaction – robot motion planning. Medical data acquisition and database systems. Visual programming concepts; Visual Basic environment, tools and controls; Dynamic data exchange; VB based Medical Information System.

UNIT IV BASIC CONCEPTS OF MULTIMEDIA **9**

Design of Multimedia information systems; Components of virtual reality; Virtual reality applications in medicine. Medical Informatics and its levels; Design and development of educational packages on medical sciences; Integrated design concepts; Interactive multimedia, Virtual and digital libraries; Internet and its applications.

UNIT V DECISION MAKING METHODS FOR BIOMEDICINE **9**

Bayesian statistics – decision analysis – Bayesian belief networks – Markov models – Markov decision Process – Applications to speech recognition, medical diagnosis. Hospital information System its design and functional characteristics; Principles and applications of Artificial Intelligence, Pattern Recognition, Neural Network and Fuzzy Logic in Medicine.

TOTAL :45 PERIODS

LIST OF EXPERIMENTS

1. Develop a Mycin expert system for diagnosis of pulmonary diseases and infectious Blood diseases.
2. Develop a DEC's XCON system for radiotherapy treatment planning.
3. Develop an expert system for clinical pathology reporting.
4. Develop an expert system for knowledge-based analysis and interpretation of serologic tests for hepatitis A, B, C and D.
5. Develop a smart doctor, an automated medical office system works as a patient goes through a typical office encounter.
6. Develop a medical expert system for vital parameter measurement, storage and retrieval for 50 patients.
7. Develop an expert system for coding medical data. The goal is to convert a narrative report, which is readable only to human beings, into a form that is usable by automated systems.
8. Develop an expert system for foetal monitoring.

TOTAL :45 PERIODS

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COURSE OUTCOMES

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

CO1: Create medical documentation.
CO2: Utilize computer skills to develop expert systems.
CO3: Analyze clinical laboratory and medical imaging data.
CO4: Create medical decision-making using computers.
CO5 : Apply medical informatics in various medical applications.

TEXT BOOKS

1. J. Van Bemmel, Mark A. Musen, Handbook of Medical Informatics, Springer Publications.
2. Date C J, " An introduction to Database Systems", Addison Wesley Publication.
3. Pentti Nieminen, "Medical Informatics and data analysis" MDPI Publishing, 2021.

REFRENCE BOOKS

1. Morris F. Collen, Marion J. Ball (Eds.), "The History of Medical Informatics in The United States" 2nd Edition , Springer-Verlag London (2015)
2. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mc Graw Hill Publishing Ltd, 2005.
3. H Dominic Covvey et al , "Computer in the practice of, medicine", Addison Wesley.
4. Nguyen Thi Dieu Linh, Zhongyu, "Data Science and Medical Informatics in Healthcare Technologies", Springer, 2021.
5. Mohan Bansal, Medical informatics Tata Mc Graw Hill Publishing computers Ltd, 2003 New Delhi.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	3	2	-
AVG	3	3	2	-	-	-	-	-	-	-	-	3	2	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE31 INTERNET OF THINGS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand Smart objects, IoT architectures, data analytics and cloud in the context of IoT.
- To learn about various IOT-related protocols.
- To build simple IoT Systems using Arduino and Raspberry Pi. and develop IoT infrastructure for popular applications.

UNIT I FUNDAMENTALS OF IoT **9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors,Actuators, Smart Objects and Connecting Smart Objects.

UNIT II IoT PROTOCOLS **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

UNIT III DESIGN AND DEVELOPMENT **9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES **9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG.

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS **9**

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming.
2. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
3. Introduction to Raspberry PI platform and python programming.
4. Interfacing sensors with Raspberry PI.
5. Communicate between Arduino and Raspberry PI using any wireless medium.
6. Setup a cloud platform to log the data.
7. Log Data using Raspberry PI and upload to the cloud platform.
8. Design an IOT based system.

TOTAL : 30 PERIODS

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COURSE OUTCOMES

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

CO1: Explain the concept of IoT.

CO2: Analyze various protocols for IoT.

CO3: Design a PoC of an IoT system using Rasperry Pi/Arduino.

CO4: Apply data analytics and use cloud offerings related to IoT.

CO5: Analyze applications of IoT in real time scenario.

TEXTBOOKS

1. 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.
2. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd, 2004.
3. Pentti Nieminen, "Medical Informatics and data analysis" MDPI Publishing, 2021.

REFERENCE BOOKS

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
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CO3	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	3	2	-
AVG	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**2**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24BMPE32 BIOMECHANICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To learn the fundamental concepts of the principles of mechanics.
- To understand the basics of biofluid and biomechanics of joints and implants.
- To review the mechanical properties of musculoskeletal elements and modelling and ergonomic design.

UNIT I INTRODUCTION TO MECHANICS **9**

Introduction – Scalars and vectors, Statics –Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics – Linear motion, Newton's laws of motion, Velocity and acceleration, Kinematics – Models, Transducers Constitutive equations –Non viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

UNIT II BIOFLUID MECHANICS **9**

Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for Non Newtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.

UNIT III MUSCULOSKELETAL MECHANICS **9**

Constitutive equation of viscoelasticity – Maxwell, Voight and Kelvin models, anisotropy, Hard Tissues – Structure, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modelling of Soft Tissues – Cartilage, Tendons and Ligaments ,Skeletal Muscle, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS AND IMPLANTS **9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V MODELLING AND ERGONOMICS **9**

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; models for voice biomechanics, Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted and whole-body vibrations.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. MATLAB implementation of Vector algebra, force and moment calculation.
2. Program used in conjunction with the EMG system to analyse muscle patterns.
3. Biomechanical analysis of voice.
4. Cardiovascular models.

5. Musculoskeletal models activation.
6. Finite element analysis.
7. Design of orthopedic implant.
8. Gait analysis.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Apply the principles of mechanics, kinetics and kinematics in the context of biological systems Appraise the basics of biofluid mechanics as applied to heart valve design and blood vessel models.

CO2: Describe the basics of biofluid mechanics as applied to heart valve design and blood vessel models.

CO3: Describe the mechanical properties of musculoskeletal elements to develop the mathematical models of joints and implants.

CO4: Apply the knowledge of biomechanics into analysis of human joints and motion.

CO5: Apply Biomechanics principles to "real-world" problem and describe their impact on health, safety, society, environment as well as underlying legal and ethical considerations.

TEXT BOOKS

1. Y.C. Fung, Bio-Mechanics- Mechanical Properties of Tissues, Springer-Verlag, 1998.
2. Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009.
3. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, Biofluid Mechanics: The Human Circulation, Taylor and Francis, 2007.

REFERENCE BOOKS

1. Sheraz S. Malik and Shahbaz S. Malik, Orthopaedic Biomechanics Made Easy, Cambridge University Press, 2015.
2. Jay D. Humphrey, Sherry De Lange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.
3. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.
4. Neil J. Mansfeild, Human Response to Vibration, CRC Press, 2005.
5. Carl J. Payton, Biomechanical Evaluation of movement in sports and Exercise, 2008.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO2	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO3	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO4	3	1	1	-	-	1	-	1	-	-	-	-	1	-
CO5	3	1	1	-	-	1	-	1	-	-	-	-	1	-
AVG	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**

1-**Low, 2-Medium, 3-High, "-" – No correlation**

24MC3101 LEGAL SYSTEM OF INDIA **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts necessity of law among engineers.
- To introduce Indian legal system.
- To familiarize taxations and basic laws.

UNIT I INTRODUCTION TO INDIAN LEGAL SYSTEM **9**

Constitution of India, Sources of Law and Judicial system.

UNIT II CONTRACTS AND ITS ELEMENTS **9**

Employment contracts, Contract Interpretation, Service Contract, Contract of Indemnity, Law of Agency. Employment agreement.

UNIT III LEGAL DOCUMENTATION **9**

Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and subcontracting

UNIT IV CYBER AND LABOUR LAWS **9**

E-Commerce and E-Governance. Provident Fund, ESIC, Gratuity, Bonus, Perquisites, Contract labour Health, Safety and welfare of construction workers.

UNIT V TAXATION **9**

Income Tax, Service Tax, VAT, Excise Duty, GST. Alternate Dispute Resolution (ADR) in Domestic and International dealings, Code of Conduct and Ethics for engineering professionals

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explore the Indian Legal System.

CO2: Explain the basics of different laws.

CO3: Acquire practical insight of legal system and its application in engineering profession.

CO4: Analyze the cyber and labour law.

CO5: Use the tax system.

TEXT BOOKS

1. Karnika Seth, Computer Internet and New Technology Laws, Lexisnexis, First Edition 2013.
2. Prafulla C Pant, The Arbitration and Conciliation Act, 1996, Butterworths India, New Delhi.
3. Joseph Minattur, Indian Legal System, Indian Law Institute, New Delhi.

REFERENCE BOOKS

1. J. Beatson, Anson's Law of Contract, Oxford University Press.
2. V. S. Datey , Indirect Taxes: Law and Practice, Taxmann Publications (P) Ltd.
3. Dr. Vinod K. Singhania and Dr. Monica Singhania , Student's Guide To Income Tax, Taxmann Publications (P) Ltd.
4. S.C. Srivastava, Industrial Relations and Labour Laws, Vikas Publishing House Pvt. Ltd.
5. Singh, M. P., & Kumar, N, The Indian legal system: An enquiry. Oxford University Press, 2019.

24MC3102 IPR AND PATENT DRAFTING **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts intellectual property.
- To familiarize the importance of patent copyrights and trademarks.
- To train the students for drafting of patent.

UNIT I BASICS OF IPR **9**

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (Movable Property, Immovable Property and Intellectual Property).

UNIT II PATENT, COPYRIGHTS AND TRADEMARKS **9**

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL PATENT FILING **9**

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement.

UNIT IV DRAFT OF PATENT **9**

Pre-drafting requirement, Types of specifications, Drafting of Provisional specifications, Drafting of complete specifications, Drafting of claims, Filing procedure for Ordinary application, Convention application, PCT International Phase application, PCT National Phase application, Patent of addition, Divisional application, Publication of paten, First Examination Report, Time limit for different phase of prosecution, Pre Grant opposition, Post Grant opposition.

UNIT V INFRINGEMENT OF PATENTS AND CASE STUDIES **9**

Infringement & remedies, Literal Infringement, Case Studies on – Patents, Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the basics of IPR.
CO2: Explore the importance of Patenting.
CO3: Discuss the method of international patent filing.
CO4: Draft of patent application.
CO5: Explain the importance of patent infringement.

TEXT BOOKS

1. Kompal Bansal, Parikshit Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications 2013.
2. Pmbuddha Ganguli, Inrelletul property right - Unleasbing the knowledge economy, Tata Mccraw HiU Publishing Company Ltd.
3. Deborah Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets Delmar Cengage Learning; 5th Edition.

REFERENCE BOOKS

1. N.K Acharya, Intellectual property rights, Asia Law House, 9th Edition.
2. Jeffrey G. Sheldon, How to Write a Patent Application, Third Edition, Practising Law Institute, 2016.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Use, 2nd Edition.
4. Dr. R. Ashok Raj, Dr. K. Panneer Selvam, and V. Sivaganesan “Introduction to Intellectual Property Rights and Patent Drafting, JBR TRY SEA Publishers, 2024.
5. The American Society of International law, Electronic resource guide, ERC publication.

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24MC3103 LITERARY FORMS AND TECHNIQUES **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To make the students aware about the finer sensibilities of human existence through an art form.
- The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.
- To gain knowledge in modern tools for visualization.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE **9**

Relevance of literature, Enhances Reading, thinking, discussing and writing skills. Develops finer sensibility for better human relationship. Increases understanding of the problem of humanity without bias. Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION **9**

Fiction, fact and literary truth. Fictional modes and patterns. Plot character and perspective.

UNIT III ELEMENTS OF POETRY **9**

Emotions and imaginations. Figurative language. Simile, metaphor, conceit, symbol, pun and irony). Personification and animation. Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA **9**

Drama as representational art. Content mode and elements. Theatrical performance. Drama as narration, mediation and persuasion. Features of tragedy, comedy and satire.

UNIT V MODERN TOOLS FOR VISUALIZATION **9**

Plot Diagram Infographic, Theme Video Tone & Mood, Visual Set, Setting Diorama or 3D Model Soundtrack for a Story, Symbolism Poster, Book Trailer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the relevance of literature in human life.
CO2: Explore the relevance various aspects in developing finer sensibilities.
CO3: Explain the essence of poetry.
CO4: Enumerate the essence of drama.
CO5: Use the modern tools for visualization.

TEXT BOOKS

1. W.H. Hudson, An Introduction to the Study of English Literature, Atlantic, 2007.
2. Mario Klarer, Routledge, An Introduction to Literary Studies, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press,1991.

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REFERENCE BOOKS

1. Wolfstuff, The Elements of Fiction: A Survey, Ulf Wolf (ed), 2014
2. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Us.
4. Kelly J. Mays "The Norton Introduction to Literature, W. W. Norton & Company, Fifteenth Edition, 2025.
5. Eleclronic resource guide ERc published online by the American Society of International law.

24MC3104 DISASTER RISK REDUCTION AND MANAGEMENT **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To impart knowledge on concepts related to disaster management.
- To acquaint with the skills for planning and organizing disaster response.
- To impart knowledge on concepts related to disaster, disaster risk reduction.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies,-Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) **9**

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT **9**

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).

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UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Use the concepts of Disaster, Vulnerability and Disaster Risk reduction.

CO2: Explore Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.

CO3: Develop disaster response skills by adopting relevant tools and technology.

CO4: Enhance awareness of institutional processes for Disaster response in the country.

CO5: Develop rudimentary ability to respond to their surroundings with potential.

TEXT BOOKS

1. Taimpo, Disaster Management and Preparedness, CRC Publications, 2016.
2. Singh R, Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications, 2017.
3. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.

REFERENCE BOOKS

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
2. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
3. Government of India, National Disaster Management Policy, 2009.
4. Shaw R., Community based Disaster risk reduction, Oxford University Press, 2016.
5. Madu, C. N., Kuei, C.-H., Madu, I. E., Ozumba, B. C., Nnadi, V. E., Odinkonigbo, U. L., & Ezeasor, I. C. (Eds.), Handbook of disaster risk reduction & management: Climate change and natural disasters. World Scientific Publishing Co, 2017.

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24MC3105 FILM APPRECIATION **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To gain knowledge on concepts film.
- To acquaint the skills on film language.
- To know the developments in films.

Theme - A: The Component of Films

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explore the components of film.
CO2: Utilize the development of film languages.
CO3: Explain the film theories.
CO4: Discuss the latest developments in film.
CO5: List the latest developments in Indian film.

TEXT BOOKS

1. Jim Piper, The Film Appreciation Book: The Film Course You Always Wanted to Take, Allworth Pr, 2014.
2. Monaco, How to read a film, Oxford University Press, 2000.
3. Bordwell, D., & Thompson, K., Film art: An introduction, 12th Edition, McGraw-Hill Education., 2020.

REFERENCE BOOKS

1. Nichols, B., Engaging cinema: An introduction to film studies. W. W. Norton & Company, 2017.
2. Cook, D. A., A history of narrative film (4th ed.). W. W. Norton & Company, 2004.
3. Giannetti, L., Understanding movies (14th ed.). Pearson, 2020.
4. Boggs, J. M., & Petrie, D. W., The art of watching films (9th ed.). McGraw-Hill Education, 2017.
5. Hayward, S. (2013). Cinema studies: The key concepts (4th ed.). Routledge.

24MC3106 WOMEN AND GENDER STUDIES

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To gain knowledge in feminism and its theory's.
- To know the woman's global, national and locals movements.
- To understand the gender and representations.

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY **9**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **9**

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE **9**

Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Distinguish between key concepts related to sex, gender, patriarchy, and gender roles.

CO2: Analyze various feminist theories, including liberal, Marxist, socialist, radical, and postmodernist perspectives.

CO3: Examine the development of women's movements globally, nationally (India), and locally.

CO4: Interpret the relationship between gender and language, including narrative forms and linguistic structures.

CO5: Evaluate the representation of gender in mainstream, alternative, and social media platforms.

TEXT BOOKS

1. Madhu Nagla, Women and Gender Studies: A Textbook, Rawat Publications; First Edition, 2025.
2. Mary S Evans, Kathy Davis and Judith Lorber, Handbook of Gender and Women's Studies, Sage Publications, 2006.
3. Gillis, M. J., & Jacobs, A. T. Introduction to women's and gender studies: An interdisciplinary approach (2nd ed.). Oxford University Press, 2019.

REFERENCE BOOKS

1. Launius, C., & Hassel, H., Threshold concepts in women's and gender studies (2nd ed.). Routledge, 2018.
2. Hunter College Women's and Gender Studies Collective. Women's realities, women's choices: An introduction to women's and gender studies. Oxford University Press, 2014.
3. Saraswati, L. A., Shaw, B., & Rellihan, H. (2017). Introduction to women's, gender, and sexuality studies. Oxford University Press
4. Clemens, C. L.Introduction to women's & gender studies. The Pennsylvania Alliance for Design of Open Textbooks (PA-ADOPT), 2023.
5. Judith Lorber, Gender Inequality: Feminist Theories and Politics, Oxford University Press, Third Edition, 2010.

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24MC5101 FOOD AND NUTRITION **L T P C**
3 0 0 0

COURSE OBJECTIVES

- Obtain knowledge of different food groups, their composition and role in diet.
- To gain knowledge of different plant and animal derived foods and their nutritive values and properties.
- To gain knowledge in different methods of processing and cooking.

UNIT I FOOD GROUPS **9**

Basic 4, 5 & 7 food groups. Functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions). Food Pyramid, My Plate. Study of various cooking methods - Boiling, steaming, stewing, frying, baking, roasting, broiling, cooking under pressure. Cereals - composition of rice, wheat, effects of cooking on parboiled and raw rice, principles of starch cookery, gelatinization.

UNIT II PULSES AND GRAMS **9**

Varieties of pulses & grams, composition, nutritive value, cooking quality of pulses, germination and its effect. Vegetables - Classification, composition, nutritive value, selection and preparation for cooking, methods and principles involved in cooking. Fruits - Composition, nutritive value, changes during ripening, methods and effects of cooking, enzymatic browning.

UNIT III BEVERAGES **9**

Classification, nutritive value, Milk based beverages- methods of preparing tea and coffee, fruit based beverages and preparation of carbonated non – alcoholic beverages. Spices and Condiments - Uses and abuses. Fats and Oils - Types of oils, function of fats and oils, shortening effects of oil, smoking point of oil, factors affecting absorption of oil. Sugar cookery- Stages of sugar cookery, crystallization and factors affecting crystallization.

UNIT IV MILK **9**

Composition, nutritive value, kinds of milk, pasteurization and homogenization of milk, changes in milk during heat processing, preparation of cheese and milk powder Egg - Structure, composition, classification, nutritive value, uses of egg in cookery, methods of cooking, foam formation and factors affecting foam formation.

UNIT V MEAT **9**

Structure, composition, nutritive value, selection of meat, post mortem changes in meat, aging, tenderness, methods of cooking meat and their effects. Poultry – types, composition, nutritive value, selection, methods of cooking. Fish - Structure, composition, nutritive value, selection of fish, methods of cooking and effects

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explore the food groups.
CO2: Explain the properties of pulses and grams.
CO3: Explain the properties of beverages.
CO4: Explore the properties of milk.
CO5: Explore the properties of meats.

TEXT BOOKS

1. M. Swaminathan. Food science, Chemistry and Experimental foods, International Book House Publication
2. Norman. N. Potter, Food Science, New York: Chapman & HalI, 1995
3. Griswold R.M, Experimental study of Foods, John Wiely & Sons, INC, New York, 1962.

REFERENCE BOOKS

1. Helen Charley, Food Science, Macmillan, 1982
2. A.G. Peckam, Foundation of Food Preparation, Collier Macmillan Ltd, 1969.
3. Modern Cookery for teaching and trade, volume I&II ,Thangam Philip. Orient Longmans Ltd.
4. Food Fundamentals by MacWiliams, John Willy and son‟s, New York.
5. Food Facts & Principles by Shakunthala manay & Shadakhraswamy.

24MC5102 DESIGN THINKING **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To learn design thinking concepts and principles.
- To use design thinking methods in every stage of the problem.
- To learn the different phases of design thinking.

UNIT I INTRODUCTION **9**

Why Design? - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.

UNIT II UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM **9**

Search field determination - Problem clarification - Understanding of the problem - Problem, analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

UNIT III IDEATION AND PROTOTYPING **9**

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

UNIT IV TESTING AND IMPLEMENTATION **9**

Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.

UNIT V FUTURE **9**

Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the principles of design thinking.
CO2: Define the problems.
CO3: Create prototype.
CO4: Test the product.
CO5: Implement the product in the market sale.

TEXT BOOKS

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2. Jeanne Liedtka and Tim Ogilvie, Designing for Growth: a design thinking tool kit for managers.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation.

REFERENCE BOOKS

1. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O'Reilly Media, 2017.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4. http://ajjuliani.com/design-thinking-activities/\
5. https://venturewell.org/class-exercices

24MC5103 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To know the contributions of sciences.
- To gain knowledge astronomy, mathematics and Ayurveda.
- To gain knowledge on technological development of India.

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UNIT I INTRODUCTION **9**

Logic and methodology of Indian sciences. An overview of Indian contributions to sciences. An overview of Indian contributions to technology.

UNIT II ASTRONOMY **9**

Development of astronomy in India. Pancanga: Indian calendrical computations. The distinct features of Indian planetary models. Computation of eclipses: Its simplicity, elegance and efficiency. Observational astronomy in India.

UNIT III MATHEMATICS **9**

An overview of the development of mathematics in India. Mathematics contained in Sulbasutras. Combinatorial aspects of the Chandassastra. Solutions to the first and second order indeterminate equations. Weaving mathematics into beautiful poetry: Bhaskaracarya. The evolution of sine function in India. The discovery of calculus by Kerala astronomers

UNIT IV AYURVEDA **9**

History of Ayurveda, Rational foundations of Ayurveda, Textual sources in Ayurveda, Ayurveda and allied disciplines, Approach to health and disease in Ayurveda – 2 lectures, Approach to diet and nutrition in Ayurveda. Modern medicine, Ayurveda and Yoga.

UNIT V TECHNOLOGICAL DEVELOPMENT IN INDIA **9**

Agriculture- Origin, development, and Ancient crops, Water management- Overview, Harappan water management, other case studies, Medieval Water structures, Pottery-technical aspects, Silpasastra: Architecture and Construction- An introduction to Silpasastra and Construction Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the Indian science.
CO2: Explore the essence of Indian astronomy.
CO3: Enumerate the development of Indian mathematics
CO4: Discuss the sources of Ayurveda.
CO5: Explain the technological development of India.

TEXT BOOKS

1. Soni, S., India's glorious scientific tradition: Exploration of ancient knowledge and modern insights. Prabhat Prakashan.2020.
2. Joseph, G. G, A passage to infinity: Medieval Indian mathematics from Kerala and its impact. SAGE Publications, 2009.
3. Mohan, K., Science and technology in colonial India. Routledge, 2023.

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REFERENCE BOOKS

1. Sarma, K. V. A history of the Kerala school of Hindu astronomy. Vishveshvarananda Institute of Sanskrit and Indological Studies, 1972.
2. Seshadri, C. S. (Ed.). Studies in the history of Indian mathematics. Hindustan Book Agency, 2010.
3. Datta, B., & Singh, A. N. History of Hindu mathematics: A source book. Asia Publishing House, 1962.
4. Kashyapa, K., Kashyapa Samhita. Chaukhambha Orientalia, 2007.
5. https://onlinecourses.swayam2.ac.in/arp19_ap87/preview.

24MC5104 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To know the human society and system.
- To understand the capitalism, fascism and communism.
- To gain knowledge in human welfare and essential elements in Indian civilization.

UNIT I HUMAN SOCIETY AND SYSYTEM **9**

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.

UNIT II CAPITALISM **9**

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, Imperialism. Liberal democracy.

UNIT III FASCISM AND COMMUNISM **9**

Fascism and totalitarianism. World War I and II. Cold war. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical Materialism, historical materialism, Russian and Chinese models.

UNIT IV HUMAN WELFARE **9**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives, Relationship with nature.

UNIT V ESSENTIAL ELEMENTS OF INDIAN CIVILIZATION **9**

Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions.

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COURSE OUTCOMES

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

CO1: Explore the human society and system.
CO2: Explain principles of capitalism.
CO3: Discuss the fascism and communism.
CO4: Explore the importance of Human Welfare.
CO5: List the essential elements of Indian civilization.

TEXT BOOKS

1. Capra, F, The Turning Point: Science, Society, and the Rising Culture (Revised ed.). HarperOne,2023.
2. Marx, K., & Engels, F. The Communist Manifesto. Penguin Classics. 2022.
3. Paxton, R. O. The Anatomy of Fascism. Vintage, 2022.

REFERENCES BOOKS

1. Kumar, S.,The Song of the Earth. Green Books, 2022.
2. Stiglitz, J. E, Globalization and Its Discontents Revisited: Anti-Globalization in the Era of Trump. Penguin UK, 2017.
3. Lenin, V. I., The State and Revolution. Penguin Random House 2024.
4. Sen, A., Development as Freedom. Oxford University Press.2022.
5. Capra, F., & Luisi, P. L., The Systems View of Life: A Unifying Vision. Cambridge University Press, 2022.

24MC5105 STATE, NATION BUILDING AND POLITICS IN INDIA **L T P C**
3 0 0 0

COURSE OBJECTIVE

- To gain knowledge in need and role of state and politics.
- To gain knowledge in Indian national movements.
- To gain knowledge in national politics and constitution.

UNIT I INTRODUCTION **9**

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.

UNIT II STATE POLITICS **9**

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary.

UNIT III INDIAN NATIONAL MOVEMENTS **9**

The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT IV CONSTITUTION OF INDIA **9**

Constitution making and the Constitution of India. Goals, objective and philosophy.

UNIT V NATIONAL POLITICS **9**

National integration and nation-building. Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario.

COURSE OUTCOMES

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

CO1: Explore the needs of politics.
CO2: Explain the organs of state politics.
CO3: Explain the history of Indian national movements.
CO4: Discuss the constitution of India.
CO5: Discuss the roles of national politics.

TEXT BOOKS

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Chatterjee, P. (Ed.). State and politics in India. Oxford University Press, 1997.

REFERENCE BOOKS

1. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
2. V. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
3. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
4. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
5. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

24MC5106 INDUSTRIAL SAFETY **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.

UNIT I SAFETY TERMINOLOGIES **9**

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS **9**

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES **9**

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.

UNIT IV WORKPLACE HEALTH AND SAFETY **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release.

UNIT V HAZARD IDENTIFICATION TECHNIQUES **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the basic concept of safety.
CO2: Obtain knowledge of Statutory Regulations and standards.
CO3: Know about the safety Activities of the Working Place.
CO4: Analyze on the impact of Occupational Exposures and their Remedies
CO5: Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
3. Asfahl, C. R., & Rieske, D. W., Industrial safety and health management (7th ed.). Pearson 2018.

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REFERENCE BOOKS

1. Frank Lees, 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition., 2012.
2. John Ridley & John Channing, Safety at Work: Routledge, 7th Edition., 2008.
3. Dan Petersen, Techniques of Safety Management: A System Approach, 2003
4. Alan Waring, Safety management system: Chapman & Hall, England 5. Society of Safety Engineers, USA, 1996
5. Ferris, R. W., & Murphy, D, Workplace safety: Establishing an effective violence prevention program. Butterworth-Heinemann.

24OCI101 ESTIMATION AND COSTING OF BUILDING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand methods for estimating quantities in a range of construction projects, including buildings, roads, and infrastructure.
- To acquire knowledge in rate analysis and cost estimation for construction activities.
- To build proficiency in drafting construction specifications, technical reports, and tender documents.

UNIT I ESTIMATION OF QUANTITIES **9**

Philosophy – Purpose – Methods of estimation – Centre line method – Long and short wall method – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit.

UNIT II COSTING AND RATE ANALYSIS **9**

Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works.

UNIT III CONSTRUCTION SPECIFICATIONS AND DOCUMENTATION **9**

Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads.

UNIT IV TYPES OF CONTRACTS **9**

Contract – Types of contracts – BOT – Types - Formation of contract – Contract conditions – Contract for labour, material, design, construction.

UNIT V PROPERTY VALUATION **9**

Definitions – Various types of valuations – Valuation methods - Necessity –Year's purchase-sinking fund- Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS (Using MS Excel Software)

1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
3. Derive an estimate for Ground plus three storied RCC Framed structure with blockwork walls.
4. Prepare the detailed estimate for the bridge with minimum 2 spans.
5. Detailed estimate for the factory building.
6. Detailed estimate for the road work cross drainage work.
7. Derive an estimate for Ground plus three storied building with load-bearing walls.
8. Preparation of valuation report in standard Government form.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Estimate quantities for construction projects using standard methods and software.

CO2: Analyze rates and create cost estimates for different construction works.

CO3: Gain skills in preparing construction specifications, reports, and tenders.

CO4: Analyze the different types of construction contracts, their formation, and how disputes are resolved.

CO5: Value the properties such as land, buildings, mortgages, and leases.

TEXT BOOKS

1. B.N Dutta 'Estimating and Costing in Civil Engineering', CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', 7th edition, University Press, 2015.
3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 2015.

REFERENCE BOOKS

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	-
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCI102 QUALITY ASSESSMENT OF BUILDING MATERIALS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To learn the importance of quality control and testing standards for building materials.
- To understand the methods for testing materials like cement, concrete, aggregates, bricks, and steel.
- To gain hands-on experience in testing the quality of building materials in the laboratory.

UNIT I INTRODUCTION TO QUALITY ASSESSMENT AND TESTING STANDARDS **9**

Importance of quality control in construction - Properties of building materials - physical, chemical, and mechanical properties - Quality assurance vs. quality control - IS codes for material testing (cement, aggregates, steel, etc.) - Sampling techniques and procedures - Acceptance criteria and reporting.

UNIT II CEMENT AND CONCRETE **9**

Types and grades of cement - Testing of cement: fineness, consistency, setting time, strength - Concrete mix design (brief introduction) – Grades of Concrete - Workability and durability tests - Compressive, tensile, and flexural strength of concrete - Nondestructive testing (NDT) - rebound hammer, ultrasonic pulse velocity. Types and roles of admixtures - Quality assessment of chemical and mineral admixtures.

UNIT III AGGREGATES **9**

Types of aggregates - fine and coarse - Tests on aggregates - sieve analysis, specific gravity, water absorption, impact value, crushing value - Bulking of sand - Alkali-aggregate reaction - IS codes relevant to aggregate testing.

UNIT IV BRICKS, BLOCKS, AND MASONRY UNITS **9**

Classification and properties of bricks and blocks - Water absorption, compressive strength, efflorescence of bricks - Testing of solid and hollow concrete blocks - Masonry mortar: types and tests - Quality standards for masonry units relevant to IS codes.

UNIT V STEEL, TIMBER, AND OTHER MATERIALS **9**

Types of steel used in construction – mild steel, HYSD, TMT - Tensile and bend tests for steel – Timber - defects, moisture content, and strength grading - Quality control for paints, plastics, and glass - Modern materials - Geosynthetics, Graphine infused materials, Fiber reinforced polymers, Phase change materials (PCMs), Recycled and sustainable materials, Geopolymer, Advanced composite materials and Nano materials.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Fineness and consistency test on cement.
2. Compressive strength test on cement mortar cubes and concrete cubes.
3. Workability test on fresh concrete using slump cone and compaction factor.
4. Compressive and flexural strength test on hardened concrete.
5. Sieve analysis and specific gravity test on aggregates.
6. Impact and crushing value test on coarse aggregates.
7. Water absorption and compressive strength test on bricks.
8. Non-Destructive test on concrete specimens.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Demonstrate the use of quality control techniques to verify building material standards.

CO2: Evaluate the properties of cement, concrete, and admixtures using standard methods and non-destructive testing.

CO3: Perform tests on different types of aggregates to evaluate their properties and compliance with relevant IS codes.

CO4: Analyze the quality of bricks and blocks to ensure they meet construction requirements.

CO5: Perform testing on steel, timber, and modern materials to determine their construction suitability.

TEXT BOOKS

1. Shetty, M.S., Concrete Technology (Theory and Practice), S. Chand and Company Ltd., 2008.
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Education, 5th Edition, 2013.
3. Varghese, P.C., Quality Control and Testing of Construction Materials, PHI Learning Pvt. Ltd., 2007.

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REFERENCE BOOKS

1. Duggal, S.K., Building Materials, New Age International Publishers, 4th Edition, 2008.
2. IS 456:2000 – Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards, New Delhi.
3. IS 383:2016 – Specification for Coarse and Fine Aggregates for Concrete, Bureau of Indian Standards, New Delhi.
4. IS 516:2018 – Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
5. IS 3495 (Parts 1 to 4):1992 – Methods of Tests of Burnt Clay Building Bricks, Bureau of Indian Standards, New Delhi.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	-
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCI103 PROJECT MANAGEMENT **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To study and understand the formulation, scheduling and various safety concepts and its requirements applied to construction projects.
- To study the various management techniques for successful completion of construction projects.
- To study the effect of management for project organization, workers, material and equipment utilization, and cost estimation.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION **9**

Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bits – resource management.

UNIT II ESTIMATION OF PROJECT COST & ECONOMICS **9**

Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.

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UNIT III PLANNING AND SCHEDULING **9**

Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.

UNIT IV SAFETY DURING CONSTRUCTION **9**

Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazardanalysis, accident investigation & accident indices-violation, penalty.

UNIT V SAFE OPERATING PROCEDURES **9**

Safety during alteration, demolition works – Earthwork, steel construction, temporary structures,masonry & concrete construction, cutting & welding - Construction equipment, materials handling- disposal & hand tools - Other hazards – fire, confined spaces, electrical safety - Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to various construction management software.
2. Planning and creating new project.
3. Scheduling and constraints using PRIMAVERA.
4. Project cost management using PRIMAVERA.
5. Construction project safety management using BIM.
6. Gantt Chart and Network Diagram Creation.
7. Critical Path Method (CPM) & PERT Analysis.
8. Risk Management Simulation.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Perform formulations of projects.
CO2: Analyze project costing.
CO3: Identify and estimate the activity in the construction.
CO4: Develop the knowledge on accidents and their causes.
CO5: Plan, assess, analyze and manage the construction project sites using CPM/PERT.

TEXT BOOKS

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 1988.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson. J. W., Hand Book of Management Consulting Services, McGraw Hill,New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA, 2017.
4. Patrick X.W. Zou, Riza Yosia Sunindijo, Strategic Safety Management in Construction andEngineering John Wiley & Sons, Ltd 2015.
5. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
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CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	-
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OCI104 BUILDING PLANNING USING VAASTU SASTRA **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the principles of Vaasthu Shastra and its role in modern building planning.
- To equip students with the knowledge of guidelines for residential and commercial spaces.
- To develop the skills to apply principles in planning spaces for maximum comfort, energy flow, and harmony.

UNIT I INTRODUCTION TO VAASTHU SHASTRA **9**

Introduction to traditional Indian building orientation concepts including Vaasthu Shastra: overview, historical context, and philosophical background. Introduction to the five elements (Pancha Bhootas), cardinal directions, and their relevance in spatial organization. Role of energy flow and psychological comfort in building planning.

UNIT II GUIDELINES FOR RESIDENTIAL BUILDINGS **9**

General Vaasthu planning guidelines for residential buildings with functional and spatial arrangements. Orientation and zoning for daylight, ventilation, and thermal comfort. Introduction to structural load considerations as per IS 875 – Part 1: Dead Loads and IS 875 – Part 2: Imposed Loads. Importance of safety, utility, and aesthetic harmony in layout design.

UNIT III PLANNING OF COMMERCIAL AND PUBLIC BUILDINGS 9

Design principles for commercial and public buildings such as offices, retail spaces, educational institutions, and hospitals. Functional requirements, circulation, and service zoning. Application of planning standards and integration with IS 875 loading codes and IS 456: Plain and Reinforced Concrete – Code of Practice.

UNIT IV CLIMATIC DESIGN & ENVIRONMENTAL INTEGRATION 9

Importance of site context, solar orientation, prevailing winds, and daylighting in building design. Incorporating passive design strategies for thermal comfort and sustainability. Overview of IS SP 41: Guidelines for Climatic Design and ECBC (Energy Conservation Building Code) basics.

UNIT V COMMON DEFECTS AND SOLUTIONS 9

Common functional and structural design issues in residential and commercial buildings. Remedial measures as per structural codes and basic planning principles. Introduction to basic concepts of defect rectification through both engineering practices and traditional approaches. Real-life examples and mini-case studies.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Vaasthu analysis of an existing residential floor plan.
2. Designing room layouts based on Vaasthu principles.
3. Vaasthu compliant commercial building layout planning.
4. Identifying and correcting Vaasthu defects in a building plan.
5. Vaasthu guidelines for entrance and exit planning.
6. Selecting a construction site based on Vaasthu considerations.
7. Kitchen layout design following Vaasthu principles.
8. Optimizing solar and wind orientation in building design using Vaasthu.

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the key principles of Vaasthu Shastra.

CO2: Apply guidelines in the design of residential and commercial buildings.

CO3: Plan spaces that promote balance, energy flow, and harmony.

CO4: Design buildings that respond to climate and environment using passive strategies and relevant IS codes.

CO5: Identify and rectify common defects in existing buildings.

TEXT BOOKS

1. Narayan, S. Vastu Shastra: For a better living. Rupa Publications, 2005.
2. Vasudevan, R. Vastu: Transcending time, tradition, and modernity. Orient BlackSwan, 2011.
3. Sastry, B. K. Vastu Shastra: The ancient Indian science of architecture. TBS Publishers, 2002.

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REFERENCE BOOKS

1. Bhat, S. Vastu for modern living. New Age International,2009.
2. Chakraborty, P. The art of Vastu Shastra. Allied Publishers, 2010.
3. Nambiar, S. M. Vastu Shastra for home and office. Srishti Publishers, 2013.
4. Kumar, P. Vastu for health, wealth, and happiness. Orient Longman, 2016.
5. Sharma, A. Practical Vastu Shastra for the home. Sterling Publishers Pvt. Ltd, 2008.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
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CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	-
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	-
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAI101 WEB TECHNOLOGY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand different Internet Technologies.
- To learn java-specific web services architecture.
- To develop web applications using frameworks.

UNIT I WEB SITE BASICS, HTML5, CSS3, WEB2.0 **9**

Web Essentials**:** Clients, Servers and Communication – The Internet – World Wide Web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 Control Elements – Drag and Drop – Audio – Video Controls – CSS3 – Inline, Embedded and External Style Sheets – Rule Cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations – Bootstrap Framework.

UNIT II CLIENT-SIDE PROGRAMMING **9**

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation- Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.

UNIT III SERVER-SIDE PROGRAMMING **9**

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.

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UNIT IV PHP AND XML **9**

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built -in functions- Form Validation. XML: Basic XML -Document Type Definition - XML Schema, XML Parsers and Validation, XSL.

UNIT V INTRODUCTION TO ANGULAR AND WEB APPLICATIONS FRAME WORKS **9**

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Create a webpage with the following using HTML
   a) To embed an image map in a webpage.
   b) To fix the hotspots.
   c) Show all the related information when the hotspots are clicked.
2. Create a webpage with all types of Cascading Style Sheets.
3. Client-side scripts for validating web form controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:
   a) To invoke servlets from HTML forms.
   b) Session tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases:
   a) For conducting online examination.
   b) For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs using XML – Schema – XSLT/XSL.
8. Write a program to design a simple calculator using (a) JavaScript (b) PHP (c) Servlet and (d) JSP.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Construct a basic website using HTML and Cascading Style Sheets.

CO2: Build dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.

CO3: Develop server-side programs using Servlets and JSP.

CO4: Construct simple web pages in PHP and to represent data in XML format.

CO5: Develop interactive web applications.

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TEXT BOOKS

1. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall,5th Edition, 2011.
2. Jeffrey C and Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2011.
3. Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st Edition, Publishing.

REFERENCE BOOKS

1. Stephen Wynkoop and John Burke, Running a Perfect Website, QUE, 2nd Edition, 1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley, 2009.
3. Gopalan N. P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.
4. Uttam K. Roy, Web Technologies, Oxford University Press, 2011.
5. Angular: Up and Running – Learning Angular, Step by Step, Shyam Seshadri, 1st Edition, O′Reilly.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	–	2	–	3	–	–	–	–	2	–	2	-	1
CO2	3	2	3	–	3	–	–	–	–	–	–	3	-	1
CO3	3	2	3	–	3	–	–	–	–	–	–	3	-	1
CO4	3	2	2	–	3	–	–	–	–	–	–	3	-	1
CO5	3	3	3	2	3	2	2	–	2	2	2	3	-	1
AVG	**3**	**2.3**	**2.6**	**2**	**3**	**2**	**2**	**-**	**2**	**2**	**2**	**2.8**	-	1

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAI102 OBJECT ORIENTED PROGRAMMING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand Object Oriented Programming concepts and basics of Java programming Language.
- To know the principles of packages, inheritance and interfaces.
- To develop a Java application with threads and generics classes.

UNIT I INTRODUCTION TO OOP AND JAVA **9**

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements –Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members-Java Doc comments

UNIT II INHERITANCE PACKAGES AND INTERFACES 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics–Types of Inheritance –Super keyword –Method Overriding – Dynamic Method Dispatch –Abstract Classes –final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access – Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTI THREADING 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions–User defined Exception. Multithreaded Programming: Java Thread Model– Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV I/O, GENERICS, STRING HANDLING 9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENT 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls:Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – ScrollPane.Layouts–FlowPane–HBoxandVBox–BorderPane–StackPane–GridPane.Menus – Basics – Menu – Menu bars – Menu Item.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Develop stack and queue data structures using classes and objects.
2. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea() that prints the area of the given shape.
3. Solve the above problem using an interface.
4. Implement exception handling and creation of user-defined exceptions.
5. Write a Java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
6. Write a program to perform file operations.
7. Develop applications to demonstrate the features of generics classes.
8. Implement single, multilevel, and hierarchical inheritance with method overriding.

TOTAL: 30 PERIODS

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COURSE OUTCOMES

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

CO1: Apply the concepts of classes and objects to solve simple problems.

CO2: Develop programs using inheritance, packages and interfaces.

CO3: Make use of exception handling mechanisms and multithreaded model to solve real- world problems.

CO4: Build Java applications with I/O packages, string classes, Collections and generics Concepts.

CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI-based applications.

TEXT BOOKS

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019.
2. Herbert Schildt, "IntroducingJavaFX8Programming",1stEdition, McGrawHill Education, New Delhi, 2015.
3. Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (The Gang of Four).

REFERENCE BOOKS

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018.
2. Head First Object-Oriented Analysis and Design" by Brett McLaughlin, Gary Pollice, and David West.
3. Meyer, Bertrand. Object-Oriented Software Construction 3rd Edition. Prentice Hall, 1997.
4. Phillips, Dusty. Python 3 Object-Oriented Programming 3rd Edition, Packt Publishing, 2022.
5. Lafore, Robert. Object-Oriented Programming in C++ 3rd Edition, Publishing, 2002.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	1	-	-	-	-	-	-	2	-	1
CO2	3	2	3	-	2	-	-	-	1	-	-	-	-	1
CO3	3	2	-	2	3	-	-	-	-	-	2	-	-	1
CO4	3	2	2	-	3	-	-	-	-	-	-	-	-	1
CO5	2	-	3	-	3	-	-	-	-	2	2	-	-	1
AVG	**2.8**	**2**	**2.5**	**2**	**2.4**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**-**	1

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAI103 COMPUTATIONAL DATA ANALYTICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures – lists, stacks, and queues.
- To understand non-linear data structures – trees and graphs.

UNIT I LISTS **9**

Abstract Data Types (ADTs) –List ADT –Array-based implementation–Linked list implementation –Singly linked lists–Circularly linked lists–Doubly-linked lists–Applications of lists–Polynomial ADT – Radix Sort – Multi lists.

UNIT II STACKS AND QUEUES **9**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion–Function Calls–Queue ADT–Operations–Circular Queue–DeQueue – Applications of Queues.

UNIT III TREES **9**

Tree ADT–Tree Traversals –Binary Tree ADT–Expression trees–Binary Search Tree ADT–AVL Trees –Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTI WAY SEARCH TREES AND GRAPHS **9**

B-Tree –B+Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal –Depth-first traversal — Bi-connectivity – Euler circuits –Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree –Prim's algorithm –Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching –Linear Search –Binary Search. Sorting –Bubble sort –Selection sort –Insertion sort – Shell sort –. Merge Sort – Hashing –Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Array implementation of Stack, Queue and Circular Queue ADTs.
2. Implementation of Singly Linked List.
3. Linked list implementation of Stack and Linear Queue ADTs.
4. Implementation of Polynomial Manipulation using Linked list.
5. Implementation of Binary Search Trees.
6. Implementation of AVL Trees.
7. Implementation of Heaps using Priority Queues.
8. A Real-world case study using LSB (Least Significant Bit) steganography in data analytics.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Define linear and non-linear data structures.

CO2: Implement linear and non–linear data structure operations.

CO3: Use appropriate linear/non–linear data structure operations for solving a given problem.

CO4: Apply appropriate graph algorithms for graph applications.

CO5: Analyze the various searching and sorting algorithms.

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007.
3. Data Science and Predictive Analytics: Biomedical and Health Applications using R (2nd Edition) by Ivo D. Dinov.

REFERENCE BOOKS

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, McGraw Hill / MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, 1st Edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.
5. Advanced Data Science and Analytics with Python by Jesús Rogel-Salazar.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	1	-	-	-	-	-	-	2	-	-
CO2	3	3	2	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	3	-	-	-	1	-	1	-	-	-
CO4	2	3	2	3	2	-	-	-	-	-	1	-	-	-
CO5	3	2	2	-	3	-	-	-	-	-	-	1	-	-
AVG	**2.8**	**2.6**	**2.3**	**3**	**2.2**	**-**	**-**	**-**	**1**	**-**	**1**	**1.5**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAI104 NETWORKING CONCEPTS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of the TCP/IP protocol suite.
- To visualize the end-to-end flow of information.

UNIT I INTRODUCTION AND APPLICATION LAYER **10**

Data Communication – Networks – Network Types – Protocol Layering – TCP/IP Protocol Suite – OSI Model – Introduction to Sockets – Application Layer Protocols: HTTP, FTP, Email Protocols (SMTP, POP3, IMAP, MIME) – DNS – SNMP

UNIT II TRANSPORT LAYER **9**

Introduction – Transport Layer Protocols: UDP, TCP – Connection Management – Flow Control – Congestion Control – Congestion Avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III NETWORK LAYER **7**

Switching: Packet Switching – Internet Protocol – IPv4 – IP Addressing – Subnetting – IPv6 – ARP, RARP, ICMP, DHCP.

UNIT IV ROUTING **7**

Routing and Protocols: Unicast Routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Path Vector Routing – BGP – Multicast Routing: DVMRP, PIM

UNIT V DATA LINK AND PHYSICAL LAYERS **12**

Data Link Layer – Framing – Flow Control – Error Control – Data Link Layer Protocols: HDLC, PPP – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) Physical Layer: Data and Signals – Performance – Transmission Media – Switching – Circuit Switching.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Learn to use commands like TCP dump, net stat, if config, ns lookup, and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a webpage using TCP sockets.
3. Applications using TCP sockets like:
   a) Echo client and echo server.
   b) Chat.
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets.
6. Write code simulating ARP/RARP protocols.
7. Study of Network Simulator (NS) and simulation of congestion control algorithms using NS.
8. Study of TCP/UDP performance using a simulation tool.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the basic layers and their functions in computer networks.

CO2: Explore the basics of how data flows from one node to another.

CO3: Analyze routing algorithms.

CO4: Describe protocols for various functions in the network.

CO5: Analyze the working of various application layer protocols.

TEXT BOOKS

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition, TMH, 2022.
3. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open-Source Approach, McGraw Hill, 2012.
5. William Stallings, Network Security Essentials: Applications and Standards.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	1	-	-	-	-	-	-	2	-	-
CO2	3	3	-	2	2	-	-	-	-	-	1	-	-	-
CO3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
CO4	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	3	-	-	-	1	2	2	1	-	-
AVG	**2.6**	**2**	**2**	**2**	**1.8**	**-**	**-**	**-**	**1**	**2**	**1.3**	**1.5**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OEI101 CONTROL SYSTEM ENGINEERING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.

UNIT I MATHEMATICAL MODELS OF PHYSICALSYSTEMS **9**

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS **9**

Standard test signals – Steady state error & error constants – Time Response of I and II order system.

UNIT III FREQUENCY RESPONSE ANALYSIS **9**

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS **9**

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion – Stability from Bode plot – Relative stability from Nyquist & Bode – Closed loop frequency response.

UNIT V STATE VARIABLE ANALYSIS **9**

Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Mathematical modelling and analysis of Mechanical and Electrical systems using transfer function approach.
2. Time domain analysis of second order system.
3. Study of stability using Routh Hurwitz criterion.
4. Root locus technique based stability analysis.
5. Frequency response and stability analysis using Bode plot.
6. Frequency response and stability analysis using Polar plot.
7. Mathematical modelling and analysis of Mechanical and Electrical systems using state space approach.
8. Test of controllability and observability of a state space model.

TOTAL: 30 PERIODS

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COURSE OUTCOMES

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

CO1: Design the basic mathematical model of physical System.

CO2: Analyze the time response analysis and techniques.

CO3: Analyze the transfer function from different plots.

CO4: Apply the stability concept in various criterion.

CO5: Assess the state models for linear and continuous Systems.

TEXT BOOKS

1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back, McGraw Hill Education, 2018.
2. Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015.
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.

REFERENCE BOOKS

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4. S . Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First impression, 2010.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	2	1	-	-	-	-	-	1	-	-
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CO3	3	3	3	2	2	2	-	-	-	-	-	1	-	-
CO4	3	3	3	2	2	1	-	-	-	-	-	1	-	-
CO5	3	3	3	1	1	1	-	-	-	-	-	1	-	-
AVG	**3**	**3**	**2.8**	**2**	**1.6**	**1.2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OEI102 POWER ELECTRONICS AND DRIVES **L T P C**

3 0 2 4

COURSE OBJECTIVES

- Different types of power semiconductor devices and their switching.
- Operation, characteristics and performance parameters of controlled rectifiers and switched mode power supplies.
- Operation of AC voltage controller and various configurations.

UNIT I SINGLE PHASE RECTIFIERS **9**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier - distortion factor - LC filters – SCR-Two transistor analogy based turn- ON, Controlled converters (1 pulse, 2 pulse) displacement factor – ripple and harmonic factor effect of source inductance, inverter angle limit.

UNIT II THREE PHASE RECTIFIERS **9**

Three phase diode rectifiers – Concern for power quality, Controlled converters (3 pulse, 6 pulse) Computation of performance parameters.

UNIT III SWITCHING POWER SUPPLIES **9**

IGBT, MOSFET: dynamic behaviour - driver and snubber circuits -low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters switching loss calculations and thermal design.

UNIT IV AC PHASE CONTROLLERS **9**

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers various configurations for SCR based single and three phase controllers.

UNIT V DRIVE CHARACTERISTICS **9**

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode.
2. Experimental verification of transfer characteristics of AC Phase Controllers.
3. Characteristics of SCR.
4. Simulation of Single Phase Rectifiers.
5. Experimental verification of transfer characteristic of AC to DC half controlled Converter.
6. Experimental verification of transfer characteristic of of AC to DC fully controlled Converter.
7. Simulation of Three Phase Rectifiers.
8. Characteristics of MOSFET and IGBT.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the operation of semiconductor devices, its dynamic characteristics.
CO2: Design low power SMPS.
CO3: Analyze the various uncontrolled rectifiers and design suitable filter circuits.
CO4: Analyze the operation of the n-pulse converters and evaluate the performance parameters.
CO5: Apply voltage control and harmonic elimination methods to inverter circuits.

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TEXT BOOKS

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.
3. Bimal.K.Bose "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2003.

REFERENCE BOOKS

1. Cyril.W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. PhilipT.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.
5. Bin Wu, Mehdi Narimani, "High-Power Converters and AC Drives", Wiley, 2nd Edition, 2017.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	2	-	-	2	2	1	-	1	-	-
CO2	3	2	2	1	2	-	-	2	2	1	-	1	-	-
CO3	3	2	2	1	2	1	-	2	2	1	-	1	-	-
CO4	3	2	2	-	2	1	-	2	2	1	-	1	-	-
CO5	3	2	2	-	2	1	-	2	2	1	-	1	-	-
AVG	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**2**	**1**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OEI103 PLC PROGRAMMING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the fundamental concepts and architecture of Programmable Logic Controllers (PLCs).
- To identify and analyze the hardware components and interfacing devices used in PLC systems.
- To develop proficiency in PLC programming techniques and logic fundamentals for automation applications**.**

UNIT I PLC BASICS **9**

Programmable Logic Controllers (PLCs): Introduction; definition & history of the PLC; Principles of Operation; Various Parts of a PLC: CPU & programmer/monitors; PLC input & output modules; Solid state memory; the processor; I/O modules; power supplies. PLC advantage & disadvantage; PLC versus Computers, PLC Application.

UNIT II PLC HARDWARE COMPONENTS **9**

The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules,I/O specifications, The CPU, Memory design, Memory Types, Programming Devices, Selection of wire types and size.

UNIT III FUNDAMENTALS OF LOGIC **9**

The Binary Concept, AND, OR and NOT functions, Boolean Algebra, Developing circuits from Boolean Expression expressions, Producing the Boolean equation from given circuit, Hardwired logic versus programmed logic, Programming word level logic instructions. Converting Relay schematics and Boolean equation into PLC Ladder Programs,

UNIT IV VARIOUS INPUT /OUTPUT DEVICES AND ITS INTERFACING WITH PLC **9**

Different types of Input devices : Switches: Push button Switches, Toggle Switches, Proximity switches, Photo switches, Temperature Switch, Pressure Switch, and Level Switch, Flow Switches, manually operated switches, Motor starters, Transducers and sensors, Transmitters etc. Their working, specification and interfacing with PLC.

UNIT V BASICS OF PLC PROGRAMMING **9**

Processor Memory Organization, Program Scan, PLC Programming languages, Relay type Instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Programming Examine if Closed and examine If Open instructions, Entering the ladder diagram, Modes of operation. Creating Ladder Diagrams from Process Control Descriptions.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to ladder programming& to implement basic logic gates.
2. Develop, Simulate and Test Ladder diagram for Bottle Filling system.
3. Develop, Simulate and Test Ladder diagram for Traffic Light Control System.
4. Develop, Simulate and Test Ladder diagram for Car Parking system.
5. Develop Simulate and Test Ladder diagram for an alarm enunciator system.
6. Develop, Simulate and Test Ladder diagram for Batch Mixer.
7. Develop and test PLC program for three phase motor in both direction.
8. Develop, Simulate and Test Ladder diagram for stepper motor control in forward and reverse direction.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Compare conventional sequential control with programmable logic control system
CO2: Develop programs using different PLC programming languages for sequential and continuous process.
CO3: Interface analog and digital input/ output devices with PLC using different communication protocol
CO4: Test the PLC based system and troubleshoot the errors associated with it.
CO5: Develop the fundamentals of logic application.

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TEXT BOOKS

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York,2019.
2. Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010.
3. Programmable Logic Controllers- Principles and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.

REFERENCE BOOKS

1. Bolton. W, "Programmble Logic Controllers", Elsevier Newnes, 6th Edition 2015.
2. https://nptel.ac.in/courses/108105062.
3. Programmable Logic Controllers- Programming Method and Applications by J.R.Hackworth and F.D Hackworth Jr., Pearson, 2004.
4. Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.
5. Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	2	-	-	2	2	1	-	1	-	-
CO2	3	2	2	1	2	-	-	2	2	1	-	1	-	-
CO3	3	2	2	1	2	1	-	2	2	1	-	1	-	-
CO4	3	2	2	-	2	1	-	2	2	1	-	1	-	-
CO5	3	2	2	-	2	1	-	2	2	1	-	1	-	-
AVG	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**2**	**1**	**-**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OEI104 ELECRONIC DEVICES AND POWER AMPLIFIERS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To introduce the fundamentals of analysis of electronic circuits.
- To provide basic understanding of semiconductor devices and analog integrated circuits.
- To explain the design and implementation of OP-AMP circuits.

UNIT I DIODES **9**

The Ideal Diode - Terminal Characteristics of Junction Diodes - Physical Operation of Diodes - Analysis of Diode Circuits - Small Signal Model and Its Application - Operation in the Reverse Breakdown Region - Zener Diodes.

UNIT II BIPOLAR JUNCTION TRANSISTOR **9**

Operation of the NPN transistor in the Active mode – Transistor Characteristics – Transistor as an Amplifier – Basic single Stage BJT Amplifier Configurations-Transistor as a Switch.

UNIT III FIELD EFFECT TRANISITOR **9**

Structure and Physical operation of Enhancement – Type MOSFET – Current Voltage Characteristics of Enhancement – Type MOSFT- The depletion type MOSFET – MOSFET as an Amplifier.

UNIT IV OUTPUT STAGES AND POWER AMPLIFIERS **9**

Classification of output Stages – Class A Output Stage – Class B Output Stage – Biasing the Class AB Stage – Power BJT Tuned Amplifiers – Push Pull Stages.

UNIT V SIGNAL GENERATOR AND WAVEFORM SHAPING CIRCUITS **9**

Basic Principles of Sinusoidal Oscillator – Op Amp- RC Oscillator Circuits – LC And Crystal Oscillators – Multivibrators – Unregulated Power Supply – Integrated Circuit Timers.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode.
2. Characteristics of BJT – CB, CE, CC
3. Op-Amp based amplifier circuits Inverting and Non-inverting amplifier.
4. Op-Amp based Differential amplifier/Instrumentation amplifier.
5. Design of Adder-subtractor circuits using Op-Amp.
6. Square wave and Tri-angular wave oscillator.
7. Op-Amp based Wien bridge and RC oscillator.
8. 555 – timer IC based astable multi-vibrator.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the structure and underlying semiconductor physics concepts.

CO2: Design circuits employing electronic devices.

CO3: Explore the characteristics of OPAMP and its internal components.

CO4: Analyze, design and implement analog electronic circuits involving OP-AMP.

CO5: Analyze, design and implement analog electronic circuits involving timer 555.

TEXT BOOKS

1. David A bell, " Electronic circuits", Oxford University Press, 2011.
2. Ramakant A Gayakwad, " Op-Amps and Linear Integrated Circuits", IV Edition, Pearson Education/PHI, 2009.
3. D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers,2014.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2010.
2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
3. Donald A Neamen, "Electronic Circuits", McGraw Hill, edition, 2007.
4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill,
5. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	2	3	3	1	-	-	2	-	-	1	1	-
CO2	2	1	2	3	3	1	-	-	2	-	-	1	1	-
CO3	2	1	2	3	3	1	-	-	2	-	-	1	1	-
CO4	2	1	2	3	3	1	-	-	2	-	-	1	1	-
CO5	2	1	2	3	3	1	-	-	2	-	-	1	1	-
AVG	**2**	**1**	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMI101 INTERNAL COMBUSTION ENGINES **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To impart the basic fundamental knowledge on IC engines and its working along with some of the recent trends in IC engine.
- To impart knowledge on cooling and lubrication.
- To study the modern engine technologies.

UNIT I INTRODUCTION IC ENGINES **9**

Introduction, Types of IC engines, Constructional details IC engine, working, principles – 2 & 4 stroke engines, Cycles – Air standard cycles, Fuel air cycles and actual cycles, Actual Indicator diagram for four stroke and two stroke engines, General fuel properties, ignition properties – octane and cetane rating, Materials for engine components.

UNIT II PETROL ENGINES **9**

Working and constructional details of petrol engines, Carburetor – constructional and working, types of carburetors, additional features in modern carburetor, A/F ratio calculation, Petrol Injection - introduction, Ignition – introduction and requirements, Battery and magneto coil ignition system, Electronic ignition system, Stages of combustion in petrol engines, Combustion chambers for petrol engine, formation of knock in petrol engine.

UNIT III DIESEL ENGINES **9**

Working and constructional details of diesel engines, fuel injection – requirements, types of injection systems – inline, distributor pumps, unit injector, Mechanical and pneumatic governors. Fuel injector, Types of injection nozzles, Spray characteristics. Injection timing, Split and multiple injection, Stages of combustion in Diesel engines, direct and indirect combustion chambers for diesel engine, knocking in diesel engine, Introduction on supercharging and turbocharging.

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UNIT IV COOLING AND LUBRICATION **9**

Requirements, Types- Air cooling and liquid cooling systems, forced circulation cooling system, pressure and Evaporative cooling systems, properties of coolants for IC engine. Need of lubrication, Lubricants for IC engines - Properties of lubricants, Types of lubrication – Mist, Wet and dry sump lubrication systems.

UNIT V MODERN TECHNOLOGIES IN IC ENGINES **9**

HCCI Engines – construction and working, CRDi injection system, GDI Technology, E – Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Valve Timing Diagram of a Four-Stroke Engine.
2. Port Timing Diagram of a Two-Stroke Engine.
3. Actual Pressure-Volume (P–V) Diagrams of Internal Combustion Engines.
4. Performance Test on a Four-Stroke Diesel Engine.
5. Heat Balance Test on a Four-Stroke Diesel Engine.
6. Morse Test on a Multi-Cylinder Petrol Engine.
7. Retardation Test on a Diesel Engine.
8. Viscosity Measurement Using a Redwood Viscometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1:Analyze air standard cycles, engine components.
CO2:Explain the working of SI engine fundamentals.
CO3:Express concept of CI engines.
CO4:Explore the purpose of cooling and lubrication.
CO5:Remember the recent trends in IC engines.

TEXT BOOKS

1. Ganesan.V., Internal Combustion Engines, Tata McGraw Hill Publishing Co., New York,1994.
2. Ramalingam. K. K., Internal Combustion Engines, Scitech publications, Chennai, 200352 Internal Combustion Engines.
3. John B.Heywood, "IC Engines fundamentals", 2nd Edition, New York: McGraw-Hill, 2018.

REFERENCE BOOKS

1. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
2. R.B. Mathur and R.P. Sharma, Internal Combustion Engines., Dhanpat Rai & Sons 2007.
3. Duffy Smith, Auto Fuel Systems, The Good Heart Willcox Company, Inc., 1987.
4. Rajput. R. K., "Internal Combustion Engines" Laxmi Publications, 2017.
5. Eric Chowenitz, Automobile Electronics, SAE Publications, 1995.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2.8	2.8	-	-	-	-	-	-	-	-	-	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMI102 TESTING OF ENGINEERING MATERIALS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To gain and understanding of the response of various metals under the application of stress and temperature.
- To build necessary theoretical back ground of the role of lattice defects in governing both elastic and plastic properties of metals will be discussed.
- Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.

UNIT I INTRODUCTION **9**

Introduction, Importance of testing Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell hardness tests. The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve.

UNIT II TENSILE TESTING **9**

Engineering stress-strain and True stress-strain curves. Tensile properties, conditions for necking. Stress-Strain diagrams for steel, Aluminum and cast iron.

UNIT III FATIGUE TESTING **9**

Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanism of fatigue failure, Effect of stress concentration, size, surface condition and environments on fatigue.

UNIT IV CREEP AND STRESS RUPTURE **9**

Introduction, The creep curve, Stress-rupture test, Structural changes during creep, Mechanism of creep deformation, theories of creep. Fracture at elevated temperature.

UNIT V NON DESTRUCTIVE TESTING **9**

Principle, Operation, Advantages and Limitations of Liquid Penetrant, Magnetic Particle, Radiography and Ultrasonic tests.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Torsion test on mild steel rod.
3. Hardness test on metal beam (Rockwell and Brinell Hardness Tests).
4. Compression test on helical spring.
5. Deflection test on carriage spring.
6. Impact Testing on mild steel rod.
7. Deflection of a cantilever wooden and steel beam.
8. Determine the deflection of a simply supported wooden and steel beam

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1:Classify mechanical testing of ferrous and non-ferrous metals and alloys.

CO2:Recognize the importance of crystal defects including dislocations in plastic deformation.

CO3:Solve the 2D vector variable problems using Finite Element technique.

CO4:Identify the testing methods for obtaining strength and hardness.

CO5:Examine the mechanisms of materials failure through fatigue and creep.

TEXT BOOKS

1. Mechanical Metallurgy – G. E. Dieter, Third edition, published by New York Mc GrawHill,1986.
2. J. Wulff,".Mechanical behavior", John Wiley & Sons Inc; Trans-ed edition.
3. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

REFERENCE BOOKS

1. Mechanical Metallurgy – White & Lemay.
2. Testing of Metallic Materials - A.V.K. Suryanarayana
3. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
4. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
5. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	2	-	-	-	-	-	-	-	-	1	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	1	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	1	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	1	-
CO5	3	3	-	2	-	-	-	-	-	-	-	-	1	-
AVG	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMI103 INDUSTRIAL LAYOUT DESIGN AND SAFETY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the industrial layout design principles, process and material flow analysis and product and equipment analysis.
- To impart knowledge layout design and algorithms.
- To study the safety planning and management.

UNIT I INTRODUCTION **9**

Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.

UNIT II FACILITIES LAYOUT DESIGN & ALGORITHMS **9**

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP- PLANOPT, Factory CAD, Factory FLOW, Plant Simulation).

UNIT III FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS **9**

Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material- Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.

UNIT IV SAFETY PLANNING & MANAGEMENT **9**

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.

UNIT V APPROACHES IN SAFETY MANAGEMENT **9**

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS

1. Simulation of Manufacturing Shop
2. Simulation of Batch Production System
3. Simulation of Multi Machine Assignment System
4. Simulation of Manufacturing and Material Handling Systems
5. Simulation of a Shop Floor
6. Simulation of Material Handling Systems
7. Write an algorithm for plant layout
8. Write an algorithm for storage and warehouse.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1:Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.

CO2:Discuss the facilities layout design algorithms and selecting appropriate software.

CO3:Describe the facilities layout problem modeling tools and algorithms for production, warehouse and material handling.

CO4:Explain the safety planning and management principles in industries.

CO5:Illustrate the various safety management approaches in industries.

TEXT BOOKS

1. Sunderesh S. Heragu, "Facilities Design", 3rd Edition, CRC Press Taylor & Francis Group, 2008.
2. L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", Tata McGraw-Hill Publishing Co. Ltd., 2005.
3. Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw-Hill Publishing Co. Ltd., 2001.

REFERENCE BOOKS

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

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	1	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	1	-
AVG	**2.6**	**2.4**	**2.67**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMI104 PRODUCT DESIGN AND PROCESS DEVELOPMENT **L T P C**

3 0 2 4

COURSE OBJECTIVES

- Applying the principles of generic development process; and understanding the organization structure for new product design and development.
- Identifying opportunity and planning for new product design and development.
- Conducting customer need analysis; and setting product specification for new product design and development.

UNIT I INTRODUCTION **9**

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development - Duration and Cost of Product Development - The Challenges of Product Development - The Product Development Process - Concept Development: The Front- End Process - Adapting the Generic Product Development Process - Product Development Process Flows - Product Development Organizations.

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING **9**

Opportunity Identification: Definition - Types of Opportunities - Tournament Structure of Opportunity Identification - Effective Opportunity Tournaments – Opportunity densification Process - Product Planning: Four Types of Product Development Projects – The Process of Product Planning.

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS **9**

Identifying Customer Needs: The Importance of Latent Needs - The Process of Identifying Customer Needs. Product Specifications: Definition - Time of Specifications Establishment - Establishing Target Specifications - Setting the Final Specifications.

UNIT IV CONCEPT GENERATION & SELECTION **9**

Concept Generation: Activity of Concept Generation - Structured Approach - Five step method of Concept Generation. Concept Selection: Methodology - Concept Screening and Concepts Scoring.

UNIT V CONCEPT TESTING & PROTOTYPING **9**

Concept Testing: Seven Step activities of concept testing. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Identifying the customer needs for a selected product.
2. Plan for the Design Process.
3. Develop Engineering Specification.
4. Generate a concept for a product.
5. Develop a clay model for a new product.
6. Perform a design calculation.
7. Fabricate a prototype model of the new product as per the design.
8. Perform economic analysis for the new product.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1:Apply the principles of generic development process; and understand the organization structure for new p1roduct design and development.

CO2:Identify opportunity and plan for new product design and development.

CO3:Conduct customer need analysis; and set product specification for new product design and development.

CO4:Generate, select, and screen the concepts for new product design and development.

CO5:Test and prototype the concepts to design and develop new products.

TEXT BOOKS

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development" McGraw-Hill Education; 7th edition, 2020.
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Managemen",t Springer, Dreamtech, 3-540-25731-4.

REFERENCE BOOKS

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S., "Effective Product Design and Development", Business One Orwin, Home Wood, 1992, ISBN 1-55623-603-4.
3. Stuart Pugh., "Total Design –Integrated Methods for Successful Product Engineering" Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.
4. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
5. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press 2018.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	1	-
AVG	**2.3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCT201 BUILDING PLANNING AND APPROVAL **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the principles of building planning, including utility, economy, aesthetics, and circulation.
- To learn the process of site selection, building orientation, and compliance with legal building regulations.
- To explore sustainable building concepts and smart technologies integrated into modern planning practices.

UNIT I FUNDAMENTALS OF BUILDING PLANNING **9**

Covers basic principles of building planning such as utility, economy, aesthetics, and circulation. Introduces types of buildings, their classification, and key components like walls, doors, windows, and stairs.

UNIT II SITE SELECTION AND ORIENTATION **9**

Explains factors affecting site selection including topography, soil, climate, and access. Emphasizes proper building orientation based on sun path, wind direction, and site features for energy efficiency and comfort.

UNIT III BUILDING RULES AND DEVELOPMENT CONTROL **9**

Introduces building byelaws and development regulations including FAR, setbacks, height limits, and open spaces. Discusses provisions of the National Building Code (NBC) and local municipal norms.

UNIT IV BUILDING APPROVAL PROCESS AND DOCUMENTATION **9**

Covers the step-by-step procedure for obtaining building permissions. Includes preparation of site plans, working drawings, and required documents. Introduces online approval systems and key authorities.

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UNIT V SUSTAINABLE AND SMART BUILDING CONCEPTS **9**

Highlights eco-friendly planning and green building features. Discusses energy-efficient design, rainwater harvesting, and green certifications (GRIHA, IGBC, LEED). Introduces smart building technologies.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Use planning principles to design practical buildings.

CO2: Follow building rules and codes.

CO3: Choose the right site for building.

CO4: Prepare the required documents for approval.

CO5: Apply green and smart technologies in building designs.

TEXT BOOKS

1. Bindra, S. P., & Arora, S. P. Building construction: Planning techniques and methods. Dhanpat Rai Publishing Company, 2013.
2. Shah, M. G., Kale, C. M., & Patki, S. Y. Building drawing. Tata McGraw-Hill Education, 2010.
3. Bureau of Indian Standards. National building code of India (NBC). Bureau of Indian Standards, 2016.

REFERENCE BOOKS

1. Varghese, P. C. Building construction. PHI Learning Pvt. Ltd,2007 Rai Publications, 2013.
2. Rangwala, S. C. Building construction. Charotar Publishing House, 2014.
3. Gopi, S. Building drawing and detailing. Pearson Education, 2010.
4. Ching, F. D. K. Architecture: Form, space, and order. Wiley,2015.
5. Birdie, G. S., & Birdie, J. S. Building design and drawing. Dhanpat Rai Publishing Company, 2004.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	3	2	-	2	3	3	-	3	3	3	-	-
CO2	2	-	3	2	-	2	3	3	-	3	3	3	-	-
CO3	2	-	3	2	-	2	3	3	-	3	3	3	-	-
CO4	2	-	3	2	-	2	3	3	-	3	3	3	-	-
CO5	2	-	3	2	-	2	3	3	-	3	3	3	-	-
AVG	**2**	-	**3**	**2**	-	**2**	**3**	**3**	-	**3**	**3**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OCT202 ENERGY EFFICIENT BUILDING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand climate-responsive design principles and their impact on building performance.
- To learn passive strategies for heating, cooling, ventilation, and daylighting in buildings.
- To apply energy-efficient design techniques for different climatic zones using relevant tools and case studies.

UNIT I INTRODUCTION **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze heat transfer, thermal comfort, and site-specific microclimate factors.

CO2: Apply passive heating and cooling strategies, including solar design elements and natural ventilation techniques.

CO3: Design effective daylighting systems using optical materials and integrate electrical lighting controls for energy efficiency.

CO4: Evaluate thermal performance and ventilation requirements for various building orientations and climate types.

CO5: Develop energy-efficient design solutions for diverse climatic zones using case studies, tools, and energy audit methods.

TEXT BOOKS

1. Jagadish, K.S., Venkatarama Reddy, B.V., Alternative Building Materials and Technologies, New Age International, 2005.
2. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.

REFERENCE BOOKS

1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 1995.
3. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.
4. Marian Keeler and Prasad Vaidya, Fundamentals of Integrated Design for Sustainable Building, John Wiley & Sons, 2016.
5. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	2	2	-	2	3	3	-	-	3	3	-	-
CO2	2	-	2	2	-	2	3	3	-	-	3	3	-	-
CO3	2	-	2	2	-	2	3	3	-	-	3	3	-	-
CO4	2	-	2	2	-	2	3	3	-	-	3	3	-	-
CO5	2	-	2	2	-	2	3	3	-	-	3	3	-	-
AVG	**2**	**-**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCT203 ENVIRONMENTAL IMPACT ASSESSMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment.
- To develop the skill to prepare environmental management plan.
- To Gain working knowledge of environmental and human-health risk assessment methods and the strategies used to manage identified risks.

UNIT I INTRODUCTION **9**

Historical development of Environmental Impact Assessment (EIA), Environmental Clearance- EIA in project cycle, legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION **10**

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT **8**

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN **9**

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.

UNIT V CASE STUDIES **9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Carry out scoping and screening of developmental projects for environmental and social assessments.

CO2: Explain different methodologies for environmental impact prediction and assessment.

CO3: Asses socio-economic investigation of the environment in a project.

CO4: Plan environmental impact assessments and environmental management plans.

CO5: Gain Knowledge to prepare environmental impact assessment reports for various projects.

TEXT BOOKS

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996.
2. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Inter science, New Jersey. 2003.
3. World Bank –Source book on EIA.

REFERENCE BOOKS

1. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.
4. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
5. Westman, Walter E., "Ecology, Impact Assessment and Environment Planning" John Wiley and Sons, Canada, 1985.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	2	2	-	2	3	3	-	-	3	3	-	-
CO2	2	3	2	2	-	2	3	3	-	-	3	3	-	-
CO3	2	3	2	2	-	2	3	3	-	-	3	3	-	-
CO4	2	3	2	2	-	2	3	3	-	-	3	3	-	-
CO5	2	3	2	2	-	2	3	3	-	-	3	3	-	-
AVG	**2**	**3**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCT204 REHABILITATION OF STRUCTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge on maintenance aspects and causes of deterioration.
- To gain an understanding of concrete quality, durability characteristics and testing techniques.
- To impart knowledge on strengthening techniques and safe demolition procedures.

UNIT I MAINTENANCE AND REPAIR STRATIGES **9**

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE **9**

Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion.

UNIT III TESTING TECHNIQUES AND PROTECTION METHODS **9**

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT IV STRENGTHENING AND REPAIR OF STRUCTURES **9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies.

UNIT V DEMOLITION **9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the importance of inspection and maintenance.
CO2: Study the Impacts of cracks, corrosion and climate on structures.
CO3: Explain about various testing techniques.
CO4: Classify the strengthening techniques and repair strategies.
CO5: Explore the safe demolition techniques.

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TEXT BOOKS

1. Shetty,M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
3. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.

REFERENCE BOOKS

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD, Govt of India, New Delhi – 2002.
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd, 2014.
4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.
5. Ravishankar.K., and Krishnamoorthy.T.S, " Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	2	3	3	-	-	3	3	-	-
CO2	2	3	3	2	-	2	3	3	-	-	3	3	-	-
CO3	2	3	3	2	-	2	3	3	-	-	3	3	-	-
CO4	2	3	3	2	-	2	3	3	-	-	3	3	-	-
CO5	2	3	3	2	-	2	3	3	-	-	3	3	-	-
AVG	2	3	3	2	-	2	3	3	-	-	3	3	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCT205 DRINKING WATER SUPPLY AND TREATMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To provide a basic understanding of water sources, quality, and supply system planning.
- To introduce the design and operation of water conveyance and treatment systems.
- To explain the components of water distribution systems and plumbing in buildings.

UNIT I SOURCES OF WATER **9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization -Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE **9**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials - Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes -appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT **9**

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation sand filters – Disinfection -Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT **9**

Water softening – Desalination- R.O. Plant – demineralization – Adsorption – Ion exchange Membrane Systems – Iron and Manganese removal – Defluoridation – Construction and Operation and Maintenance aspects.

UNIT V WATER DISTRIBUTION AND SUPPLY **9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics – Computer applications – Appurtenances – Leak detection – Principles of design of water supply in buildings – House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Identify different sources of water and assess their suitability for supply.

CO2: Design of intake structures, pipes, and pumps used in water conveyance.

CO3: Explain the processes involved in water treatment and apply them in plant design.

CO4: Describe advanced treatment methods like softening, desalination, and removal of contaminants.

CO5: Design water distribution systems and understand plumbing arrangements in buildings.

TEXT BOOKS

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, “Water supply Engineering” Laxmi Publications (p) LTD, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", Charotar Publishing house Pvt.Ltd, February 2022.

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REFERENCE BOOKS

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, "Water Supply Engineering", McGraw Hill book Co,1984.
3. Steel. E.W.et al., "Water Supply Engineering", Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.
5. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	2	-	3	3	2	-	-	2	3	-	-
CO2	2	2	3	2	-	3	3	2	-	-	2	3	-	-
CO3	2	2	3	2	-	3	3	2	-	-	2	3	-	-
CO4	2	2	3	2	-	3	3	2	-	-	2	3	-	-
CO5	2	2	3	2	-	3	3	2	-	-	2	3	-	-
AVG	**2**	**2**	**3**	**2**	**-**	**3**	**3**	**2**	**-**	**-**	**2**	**3**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OCT206 PROJECT SCHEDULING AND OPTIMIZATION USING CPM AND PERT TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand fundamental project management concepts and principles.
- To learn principles and processes related to project scope management.
- To comprehend concepts and tools related to project scheduling and their applications in real-world projects.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION **9**

Introduction to Projects, Types of Projects, Introduction to Construction Project Management, Project Lifecycle and its Phases, Key Activities Involved in Different Project Lifecycle Phases, Role of Various Stakeholders in Different Project Lifecycle Phases, Project Organization Structure and its Types.

UNIT II PROJECT SCOPE MANAGEMENT **9**

Gathering Project Requirements, Project Scope and Specifications, Project Scope Matrix, Project Contract Management, Work Breakdown Structure (WBS), WBS Types, Creating WBS, Scope Management Steps and Processes

UNIT II PROJECT PLANNING AND SCHEDULING **9**

Project Planning, Planning and Scheduling, Steps Involved in Project Planning, Networking and Non-Networking Techniques Scheduling Techniques, Gantt-Chart, Formulation and Applications of Critical Path Method (CPM), Program Evaluation & Review Technique (PERT) and Precedence Diagram Method (PDM), Introduction to Linear Scheduling Methods

UNIT IV PROJECT CONTROL **9**

Time-Cost Tradeoff, Earned Value Management (EVM), Crashing and Fast-tracking Projects, Resource Constrained Scheduling, Resource Levelling, Schedule Updation and Project Control.

UNIT V ADVANCED TOOLS IN PROJECT SCHEDULING **9**

Software Applications and Use of AI in Project Planning, Scheduling and Control, Data driven Decision Making

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the fundamental project management concepts and principles.

CO2: Comprehend the principles and processes related to project scope management.

CO3: Gain the ability to apply concepts and tools related to project scheduling in real world Projects.

CO4: Comprehend the use of advanced project scheduling tools.

CO5: Assess the use of advanced technology platforms in project scheduling and control.

TEXT BOOKS

1. Oberlender, G. D., & Oberlender, G. D. Project management for engineering and construction (Vol. 2). New York: McGraw-Hill,1993.
2. Sears, S. K., Sears, G. A., & Clough, R. H. Construction project management: A practical guide to field construction management. John Wiley & Sons,2010.
3. Callahan, M. T., Quackenbush, D. G., & Rowings, J. E. Construction project scheduling,1992.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA , 2017.
4. Guide, P. M. B. O. K. A guide to the project management body of knowledge,2008.
5. Mubarak, S. A. Construction project scheduling and control. John Wiley & Sons,2015.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	-	2	-	3	3	2	3	3	-	-
CO2	2	3	3	2	-	2	-	3	3	2	3	3	-	-
CO3	2	3	3	2	-	2	-	3	3	2	3	3	-	-
CO4	2	3	3	2	-	2	-	3	3	2	3	3	-	-
CO5	2	3	3	2	-	2	-	3	3	2	3	3	-	-
AVG	**2**	**3**	**3**	**2**	**-**	**2**	**-**	**3**	**3**	**2**	**3**	**3**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAT201 PRINCIPLES OF PROGRAMMING LANGUAGES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand and describe syntax and semantics of programming languages.
- To understand data, data types, and basic statements.
- To understand call-return architecture and ways of implementing them.

UNIT I SYNTAX AND SEMANTICS **9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing.

UNIT II DATA, DATATYPES AND BASIC STATEMENTS **9**

Names–variables–binding–type checking–scope–scope rules–life time and garbage collection–primitive datatypes –strings–array types–associative arrays–record Types– union types–pointers and references–Arithmetic expressions–overloaded operators– type conversions–relational and boolean expressions– assignment statements– mixed mode assignments– control structures– selection– iterations– branching– guarded statements.

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS **9**

Sub programs –design issues–local referencing–parameter passing–overloaded methods–generic methods – design issues for functions– semantics of call and return – implementing simple sub programs–stack and dynamic local variables–nested sub programs – blocks – dynamic scoping

UNIT IV OBJECT-ORIENTATION, CONCURRENCY AND EVENT HANDLING **9**

Object - orientation– design issues for OOP languages– implementation of object- oriented constructs –concurrency– semaphores – monitors –message passing – threads – statement level concurrency – exception handling – event handling

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UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Describe syntax and semantics of programming languages.

CO2: Explain data, data types, and basic statements of programming languages.

CO3: Design and implement subprogram constructs.

CO4: Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML, and Prolog.

CO5: Adopt new programming languages.

TEXT BOOKS

1. Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, "Programming Language Pragmatics",Fourth Edition, Elsevier, 2018.
3. Principles of Programming Languages" by Er. Anil Panghal & Ms. Sharda Panghal.

REFERENCE BOOKS

1. R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall,2011.
2. Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson,1997.
3. W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.
4. Principles of Programming Languages" by Bruce J. MacLennan.
5. Essentials of Programming Languages" by Daniel P. Friedman, Mitchell Wand, and Christopher T. Haynes.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	1	-	-	-
CO4	3	2	2	-	3	-	-	-	1	1	1	-	-	-
CO5	2	2	-	-	2	-	-	-	-	-	-	3	-	-
AVG	**2.8**	**2.2**	**2**	**-**	**2.2**	**-**	**-**	**-**	**1**	**1**	**1**	**3**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OAT202 INFORMATION SECURITY MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management

UNIT I INTRODUCTION **9**

History - What is Information Security? - Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing the Components - Balancing Security and Access - The SDLC - The Security SDLC.

UNIT II SECURITY INVESTIGATION **9**

Need for Security - Business Needs - Threats - Attacks - Legal - Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix - Policy - Security policies - Confidentiality policies - Integrity policies and Hybrid policies.

UNIT III SECURITY ANALYSIS **9**

Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk - Systems: Access Control Mechanisms - Information Flow and Confinement Problem.

UNIT IV LOGICAL DESIGN **9**

Blueprint for Security - Information Security Policy - Standards and Practices - ISO 17799/BS 7799 - NIST Models - VISA - International Security Model - Design of Security Architecture - Planning for Continuity.

UNIT V PHYSICAL DESIGN **9**

Security Technology - IDS - Scanning and Analysis Tools - Cryptography - Access Control Devices - Physical Security - Security and Personnel.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Illustrate the legal, ethical and professional issues in information security.
CO2: Demonstrate the aspects of risk management.
CO3: Become aware of various standards in the Information Security System.
CO4: Design and implementation of Security Techniques.
CO5: Apply security technologies and practices to secure physical and logical components, including Cryptography, IDS, and physical security measures.

TEXT BOOKS

1. Michael E Whitman, Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003.
2. Information Security Management: Concepts and Practice" by Bel G. Raggad.
3. Information Security Management, 2nd Edition" by Michael Workman.

REFERENCE BOOKS

1. Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", Vol. 1 3, CRC Press LLC, 2004
2. Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw Hill, 2003.
3. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2002.
4. A Comprehensive Guide to Information Security Management and Audit" by Rajkumar Banoth, Gugulothu Narsimha, and Aruna Kranthi Godishala.
5. Richard O'Hanley and James S. Tiller, "Information Security Management Handbook", Volume 7, 6th Edition.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	-	-	-	3	-	3	-	2	-	-	-	1
CO2	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO3	2	1	-	-	1	-	1	-	-	-	-	2	-	1
CO4	3	2	3	-	3	-	-	-	-	-	1	-	-	1
CO5	3	2	3	-	3	-	-	-	-	-	1	-	-	1
AVG	**2.4**	**1.8**	**3**	**2**	**2.3**	**3**	**1**	**3**	**-**	**2**	**1.3**	**2**	**-**	**1**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAT203 HUMAN COMPUTER INTERACTION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the theoretical dimensions of human factors involved in the acceptance of computer.
- To understand the important aspects of implementation of human computer interfaces.
- To identify the various tools and techniques for interface analysis, design and evaluation.

UNIT I INTRODUCTION **9**

HCI Foundations: Input–output channels - Human memory - Thinking: reasoning and problem solving - Emotion - Individual differences - Psychology and the design of interactive systems - Text entry devices - Positioning - pointing and drawing - Display devices - Devices for virtual reality and 3D interaction - Physical controls - sensors and special devices - Paper: printing and scanning.

UNIT II INTERACTION DESIGNS **9**

Designing - Programming Interactive systems - Models of interaction - Frameworks and HCI - Ergonomics - Interaction styles - Elements of the WIMP interface - The context of the interaction - Experience - engagement and fun - Paradigms for interaction. Cantered Design and testing - Interaction design basics - The process of design - User focus - Scenarios - Navigation design - Screen design and layout, Iteration and prototyping.

UNIT III DESIGN RULES **9**

HCI in the software process - Iterative design and prototyping - Design rules - Principles to support usability - Standards and Guidelines - Golden rules and heuristics - HCI patterns. Implementation support - Elements of windowing systems - Programming the application - Using toolkits - User interface management systems.

UNIT IV ANALYSIS **9**

Evaluation techniques - Evaluation through expert analysis - Evaluation through user participation - Universal design - User support. Models and Theories - Cognitive models - Goal and task hierarchies - Linguistic models - The challenge of display-based systems - Physical and device models - Cognitive architectures.

UNIT V NOTATIONS **9**

Collaboration and communication - Face-to-face communication - Conversation - Text-based communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design Human factors and security - Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware - Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

COURSE OUTCOMES

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

CO 1: Design and Develop processes and life cycle of Human Computer Interaction.

CO 2: Analyse product usability evaluations and testing methods.

CO 3: Apply the interface design standards/guidelines for cross cultural and disabled users.

CO 4: Categorize, Design and Develop Human Computer Interaction in proper architectural structures.

CO5: Design collaborative and communicative interfaces, incorporating human factors and security.

TEXT BOOKS

1. A Dix, Janet Finlay, G D Abowd, R Beale, “Human - Computer Interaction”, Pearson Publishers, Third Edition, 2008.
2. Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Pearson Publishers, Fifth Edition, 2018.
3. Interaction Design: Beyond Human-Computer Interaction" (5th Edition) by Jenny Preece, Yvonne Rogers, and Helen Sharp.

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REFERENCE BOOKS

1. Jonathan Lazar, “Research Methods in Human–Computer Interaction”, John Wiley & Sons.
2. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications" (3rd Edition) edited by Julie A. Jacko.
3. The Design of Everyday Things" by Don Norman. "Designing Interactions" by Bill Moggridge.
4. Jef Raskin , “The Humane Interface: New Directions for Designing Interactive Systems”.
5. Human Computer Interaction, https://onlinecourses.nptel.ac.in/noc25_cs38/preview.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	3	-	2	-	-	-	-	-	1	-
CO2	2	-	2	-	2	-	3	-	-	-	-	-	1	-
CO3	3	2	3	2	3	-	2	-	-	-	2	-	1	-
CO4	2	2	2	-	2	-	2	-	-	-	-	-	1	-
CO5	2	-	-	-	2	2	2	3	-	-	-	2	1	-
AVG	**2.4**	**2**	**2.3**	**2**	**2.4**	**2**	**2.2**	**3**	**-**	**-**	**2**	**2**	**1**	**-**

1-Low, 2-Medium, 3-High, “-” – No correlation

24OAT204 COMPUTER APPLICATION IN AGRICULTURES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming and environmental control systems
- To also expose the students to IT applications in agricultural systems management and weather prediction models.

UNITI PRECISION FARMING **9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS **9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO2consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

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UNIT III AGRICULTURAL SYSTEMS MANAGEMENT **9**

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS **9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS **9**

Expert systems, decision support systems, Agricultural and biological data bases, e-commerce, e- business systems & applications, Technology enhanced learning systems and solutions, e- learning, Rural development and information society.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the applications of IT in remote sensing applications such as Drones, etc.
CO2: Discuss how the greenhouse can be automated.
CO3: Apply IT principles and concepts for management of field operations.
CO4: Discuss about weather models, their inputs, and applications.
CO5: Use the e-governance in agriculture.

TEXT BOOKS

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.
3. Computers in Agriculture" by Manish Kumar Sharma, Anil Bhat & M. Iqbal Jeelani Bhat.

REFERENCE BOOKS

1. Peart, R.M.,and Shoup,W.D.,"Agricultural Systems Management", Marcel Dekker, New York,2004.
2. Hammer,G.L., Nicholls,N.,and Mitchell,C., "Applications of Seasonal Climate", Springer, Germany,2000.
3. ICT & its Applications in Agriculture" by Golla Ravi, MD. Mubeena, Apoorva Veldandi.
4. Communication Technologies in Agriculture" by Dr. P. Jaisridhar & Mrs. Surudhi.
5. Internet and Computers for Agriculture" edited by Dimitre Dimitrov.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	3	-	2	-	-	-	1	2	-	-
CO2	3	2	2	-	3	-	2	-	-	-	1	2	-	-
CO3	3	3	3	2	3	1	2	-	-	-	3	2	-	-
CO4	2	2	-	2	2	-	3	-	-	-	2	2	-	-
CO5	2	2	2	-	2	-	2	2	1	2	3	2	-	-
AVG	**2.6**	**2.4**	**2.3**	**2**	**2.6**	**1**	**2.2**	**2**	**1**	**2**	**2**	**2**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OAT205 MOBILE COMPUTING **L T P C**

3 0 0 3

COUSE OBJECTIVES

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system.
- To be familiar with the network layer protocols and Ad-Hoc networks.

UNIT I INTRODUCTION **9**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.

UNIT II MOBILE TELECOMMUNICATION SYSTEM **9**

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS-UMTS – Architecture – Handover – Security.

UNIT III MOBILE NETWORK LAYER **9**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER **9**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML.

UNIT V MOBILE PLATFORMS AND APPLICATIONS **9**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO 1: Explain the basics of mobile telecommunication systems.

CO 2: Illustrate the generations of telecommunication systems in wireless networks.

CO 3: Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.

CO 4: Explain the functionality of Transport and Application layers.

CO 5: Develop a mobile application using android/blackberry/ios/Windows SDK.

TEXT BOOKS

1. Jochen Schiller, —Mobile Communications‖, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012
3. Mobile Computing: Concepts, Methodologies, Tools, and Applications (6 Volumes) edited by David

REFERENCE BOOKS

1. Dharma Prakash Agarval, Qing and An Zeng, —Introduction to Wireless and Mobile systems‖,Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing‖, Springer, 2003.
3. William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition,TataMcGraw Hill Edition ,2006.
4. C.K.Toh, —AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.
5. Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications (4 Volumes) by Information Resources Management Association.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	2	-	-	-	-	-	-	-	-	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	-	1
CO4	2	2	-	-	2	-	-	-	-	-	-	-	-	1
CO5	2	2	3	-	3	-	-	-	1	2	2	2	-	1
AVG	**2.6**	**2.2**	**3**	**2**	**2.4**				**1**	**2**	**2**	**2**	-	1

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OAT206 OBJECT ORIENTED ANALYSIS AND DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamentals of Object-Oriented Analysis and Design (OOAD) using the Unified Process and various UML diagrams.
- To enable students to model software systems using static and dynamic UML diagrams such as class, use-case, sequence, state, and activity diagrams.
- To develop the ability to apply GRASP principles and GoF design patterns to design robust, maintainable, and scalable object-oriented systems.

UNIT I UNIFIED PROCESS AND USE CASE DIAGRAMS **9**

Introduction to OOAD with OO Basics — Unified Process — UML diagrams — Use Case – Case study — the Next Gen POS system, Inception -Use case Modelling — Relating Use cases — include, extend and generalization — When to use Use-cases

UNIT II STATIC UML DIAGRAMS **9**

Class Diagram—- Elaboration — Domain Model — Finding conceptual classes and description classes — Associations — Attributes — Domain model refinement — Finding conceptual class Hierarchies — Aggregation and Composition — Relationship between sequence diagrams and use cases — When to use Class Diagrams

UNIT III DYNAMIC AND IMPLEMENTATION UML DIAGRAMS **9**

Dynamic Diagrams — UML interaction diagrams — System sequence diagram — Collaboration diagram — When to use Communication Diagrams — State machine diagram and Modelling –When to use State Diagrams — Activity diagram — When to use activity diagrams Implementation Diagrams — UML package diagram — When to use package diagrams — Component and Deployment Diagrams — When to use Component and Deployment diagrams

UNIT IV DESIGN PATTERNS **9**

GRASP: Designing objects with responsibilities — Creator — Information expert — Low Coupling — High Cohesion — Controller Design Patterns — creational — factory method — structural — Bridge — Adapter — behavioural — Strategy — observer –Applying GoF design patterns — Mapping design to code

UNIT V TESTING **9**

Object Oriented Methodologies — Software Quality Assurance — Impact of object orientation on Testing — Develop Test Cases and Test Plans

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explain OOAD principles and apply the Unified Process in software development.

CO2: Create and analyze static UML diagrams such as class and domain models.

CO3: Model dynamic behaviors using sequence, state, activity, and implementation diagrams.

CO4: Apply design patterns and GRASP principles in object-oriented design.

CO5: Evaluate object-oriented systems through testing and quality assurance methods.

TEXT BOOKS

1. Booch, Grady,"Object-Oriented Analysis and Design with Applications",3rd Edition, Addison-Wesley Professional, 2007.
2. McLaughlin, Brett, Gary Pollice and David West,"Head First Object-Oriented Analysis and Design", O'Reilly Media, 2006.
3. Gamma, Erich, Richard Helm, Ralph Johnson and John Vlissides. "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994.

REFERENCE BOOKS

1. Booch, Grady, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Addison-Wesley Professional, 2007.
2. Larman, Craig, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2004.
3. Gamma, Erich; Helm, Richard; Johnson, Ralph; Vlissides, John, "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994.
4. Fowler, Martin, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", 3rd Edition, Addison-Wesley Professional, 2003.
5. Pressman, Roger S., "Software Engineering: A Practitioner's Approach" 8th Edition, McGraw-Hill Education, 2014.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	1	-	-	-	-	2	-	1	-	-
CO2	2	3	3	-	1	-	-	-	2	2	-	1	-	-
CO3	2	3	3	1	1	-	-	-	-	2	-	1	-	-
CO4	3	2	3	-	2	-	-	-	-	1	2	1	-	-
CO5	1	2	2	-	1	-	-	-	-	1	2	1	-	-
AVG	**2.2**	**2.4**	**2.6**	**1**	**1.2**	**-**	**-**	**-**	**2**	**1.6**	**2**	**1**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OET101 ELECTRIC VEHICLE TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the concept and operations of electric and hybrid electric vehicles (EVs and HEVs), including their architecture.
- To explore the need for energy storage in hybrid vehicle and the technologies available for energy storage.
- To provide an overview of various energy storage technologies applicable to electric vehicles.

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS **9**

Electric Vehicles (EV),Hybrid Electric Vehicles (HEV), Engine ratings – Comparisons of EV with internal combustion Engine vehicles – Fundamentals of vehicle mechanics.

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS **9**

Architecture of EV's and HEV's - Plug-n Hybrid Electric Vehicles (PHEV) – Power train components and sizing,Gears,Clutches,Transmission and Brakes.

UNIT III POWER ELECTRONICS AND MOTOR DRIVES **9**

Electric drive components – Power electronic switches – four quadrant operation of DC drive – Induction motor and permanent magnet synchronous motor – based vector control operation – Switched Reluctance Motor (SRM) drives – EV motor sizing.

UNIT IV BATTERY ENERGY STORAGE SYSTEM **9**

Battery Basics – Different types – Battery Parameters – Battery life and safety - Battery modeling – Design of battery for large vehicles.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS **9**

Introduction to fuel cell – Types, operation and Characteristics – proton exchange membrane (PEM) fuel cell for E-mobility – hydrogen storage systems – Super capacitors for transportation applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Utilize the concept of electric vehicle and energy storage systems.
CO2: Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle.
CO3: Explain the principles of power converters and electrical drives.
CO4: Illustrate the operation of storage systems such as battery and super capacitor.
CO5: Analyze the various energy storage systems based on fuel cells and hydrogen storage.

TEXT BOOKS

1. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017
2. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley,2012.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.

REFERENCE BOOKS

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata Mc Graw Hill, 7th Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Hand book, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
4. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021.
5. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	2	3	3	1	-	-	2	-	-	1	-	-
CO2	2	1	2	3	3	1	-	-	2	-	-	1	-	-
CO3	2	1	2	3	3	1	-	-	2	-	-	1	-	-
CO4	2	1	2	3	3	1	-	-	2	-	-	1	-	-
CO5	2	1	2	3	3	1	-	-	2	-	-	1	-	-
AVG	**2**	**1**	**2**	**3**	**3**	**1**	-	-	**2**	-	-	**1**	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OET102 POWER SYSTEM **L T P C**

3 0 0 3

COURSE OBJECTVES

- To develop a comprehensive understanding of power system components, their operation, and the overall structure of electrical power systems.
- To acquire the knowledge of transmission line parameters, insulators, cables, and protective devices such as circuit breakers, enabling effective design, analysis, and maintenance of power systems.
- To familiarize students with modern control and monitoring techniques in power systems.

UNIT I INTRODUCTION **9**

Power scenario in India – Power system components – Structure of Power System – Types of Power – Substation layout components.

UNIT II TRANSMISSION LINE PARAMETERS **9**

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, conductor types – Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD; skin and proximity effects.

UNIT III INSULATORS AND CABLES **9**

Main components of overhead lines-Insulators-Types, voltage distribution in insulator string, improvement of string efficiency, Underground cables-Types of cables, insulation materials, Parameters of cable, Grading of cables, Capacitance of 3-core cable, heating, thermal resistance of cables.

UNIT IV COMPUTER CONTROL OF POWER SYSTEMS **9**

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

UNIT V CIRCUIT BREAKERS **9**

Types of circuit breakers – air blast, air break, oil,SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers –Rating and selection of Circuit breakers – Relays.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain Power System Components and Structure.
CO2: Analyze Transmission Line Parameters and Performance.
CO3: Design and Selection of Insulators and Cables.
CO4: Discuss application of Computer Control Systems in Power Systems.
CO5: Interpret the knowledge of Circuit Breakers and Protective Devices

TEXT BOOKS

1. S.N.Singh, 'Electric Power Generation ,Transmission and Distribution', Prentice Hall of India Pvt.Ltd, New Delhi, 2008.
2. B.R.Gupta,' Power System Analysis and Design', S.Chand, New Delhi, Fifth Edition2005-08.
3. J.Brian, Hardy and Colin R.Bayliss' Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.

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REFERENCE BOOKS

1. R.K.Rajput, 'Power System Engineering' Laxmi Publications (P) Ltd, New Delhi, 2006.
2. D.P.Kothari, I.J.Nagarath, 'Power System Engineering' Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007.
3. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
4. Luces M.Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
5. Hadi Saadat, 'Power System Analysis, 'PSA Publishing; Third Edition, 2010.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	-	1	2	-	-	1	-	-	-	-
CO2	3	2	2	-	-	1	2	-	-	1	-	-	-	-
CO3	3	2	2	-	-	1	2	-	-	1	-	-	-	-
CO4	3	2	2	-	-	1	2	-	-	1	-	-	-	-
CO5	3	2	2	-	-	1	2	-	-	1	-	-	-	-
AVG	**3**	**2**	**2**	**-**	**-**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OET103 CIRCUIT THEORY **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce electric circuits, including their analysis, solving circuit equations using network theorems, and understanding phasor diagrams and three-phase circuit analysis.
- To explain the phenomenon of resonance in coupled circuits and its significance.
- To educate on determining the transient response of circuits and analyzing their dynamic behavior.

UNIT I BASIC CIRCUITS ANALYSIS **9**

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis.

UNIT II NETWORK REDUCTION AND THEOREMS **9**

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS **9**

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV THREE PHASE CIRCUITS **9**

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V RESONANCE AND COUPLED CIRCUITS **9**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Enumerate the concepts of electrical circuits, and fundamental laws.
CO2: Analyze electric circuits with theorem.
CO3: Analyze the concepts of Three phase circuits.
CO4: Analyze the concepts of resonance circuits.
CO5: Analyze the transient response of circuits.

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi,2015.
5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	2	3	2	-	-	-	-	-	-	3	1	-
CO2	3	3	3	3	2	-	-	-	-	-	-	2	1	-
CO3	2	3	2	3	3	-	-	-	-	-	-	1	1	-
CO4	3	2	2	2	2	-	-	-	-	-	-	3	1	-
CO5	3	3	3	2	2	-	-	-	-	-	-	1	1	-
AVG	**2.8**	**2.8**	**2.2**	**2.8**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OT104 ADVANCED ELECTRICAL MACHINES **L T P C**
3 0 0 3

COURSE OBJECTIVS

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM.
- To derive torque equation and study the characteristics of special machines.
- To design the controller for special machines and study the working principle of synchronous reluctance motor.

UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS **9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control.

UNIT II PERMANENT MAGNET SYNCHROUNOUS MOTORS **9**

Principle of operation – EMF and torque equations - Phasor diagram - Power controllers– performance characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT III SWITCHED RELUCTANCE MOTORS **9**

Constructional features –Principle of operation- Torque prediction –performance Characteristics-Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT IV STEPPER MOTORS **9**

Constructional features –Principle of operation –Types – Different modes of excitation - Torque equation – Characteristics – Drive circuits – Closed loop control – Applications.

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES **9**

Principle of operation and characteristics of Hysteresis motor – Universal motor – Linear induction motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Utilize the control and characteristics for PMBDC motors.
CO2: Optimally design magnetic required in special machines based drive systems using FEM based software tools.
CO3: Analyze the dynamic performance of special electrical machine.
CO4: Explain the operation and characteristics of other special electrical machines.
CO5: Design and conduct experiments towards research.

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TEXT BOOKS

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and their Microprocessor Controls', Clarendon Press London, 1984
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

REFERENCE BOOKS

1. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London,1989
2. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000 Dekker 2009
3. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design and Applications -CRC Press 2017.
4. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives:fundamentals to applications-CRC 2019.
5. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives - CRC Press, Marcel Applications -CRC Press 2009.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	2	3	1	-	-	-	-	-	1	-	-
CO2	2	3	3	2	3	1	-	-	-	-	-	1	-	-
CO3	2	3	3	2	3	1	-	-	-	-	-	1	-	-
CO4	1	1	1	2	2	1	-	-	-	-	-	1	-	-
CO5	1	2	2	2	1	1	-	-	-	-	-	1	-	-
AVG	1.6	2.4	2.2	2.2	3	1	-	-	-	-	-	1	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OET105 HYBRID RENEWABLE POWER GENERATION **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To learn the working principles and integration of different renewable energy sources.
- To understand the power electronic interfaces and control strategies used in hybrid systems
- To analyze energy storage systems and battery management techniques used in hybrid technologies.

UNIT I HYDRID ENERGY SYSTEMS **9**

Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources

UNIT II ENERGY STORAGE AND CONTROL SYSTEMS **9**

Energy storage systems: Batteries, flywheels, compressed air, supercapacitors, and pumped hydro- Battery management systems and charge controllers-Control strategies for hybrid systems-Load forecasting and demand-side management.

UNIT III POWER CONVERTERS AND ANALYSIS OF HYBRID SOLAR PV SYSTEMS **9**

Power converters for Solar PV systems: Line-commutated converters (inversion-mode), boost and buck-boost converter-Selection of inverters, battery sizing, and array sizing- Analysis of Solar PV systems: Block diagrams and types (stand-alone PV systems)

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS **9**

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter –Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS **9**

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the classification, need, and benefits of hybrid energy systems.
CO2: Explain various energy storage systems and control mechanisms for hybrid systems
CO3: Analyze different combinations of renewable energy sources.
CO4: Design and select appropriate converters and control strategies for hybrid systems.
CO5: Interpret real-time case studies of hybrid systems.

TEXT BOOKS

1. Md. Rabiul Islam et al., Emerging Power Converters for Renewable Energy and Electric Vehicles, CRC Press, First Edition, 2021
2. G.D. Rai, Solar Energy Utilization, Khanna Publishers, 3rd Edition, 1987
3. B.H. Khan, Non-Conventional Energy Sources, Tata McGraw-Hill Publishing Company, New Delhi, 2017, 3rd Edition.

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REFERENCE BOOKS

1. S.N. Bhadra, D. Kastha, & S. Banerjee, Wind Electrical Systems, Oxford University Press, 2005.Rashid M.H., Power Electronics Handbook, Academic Press, 4th Edition, 2018.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 6th Edition, 2017.
3. Gray L. Johnson, Wind Energy System, Prentice Hall of India, 2nd Edition, 2006
4. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
5. G.D. Rai, Solar Energy Utilization, Khanna Publishers, 3rd Edition, 1987.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO2	3	3	-	-	3	-	2	1	-	2	-	-	-	-
CO3	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO4	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO5	3	-	-	-	-	-	2	1	-	2	-	-	-	-
AVG	**3**	**3**	**-**	**-**	**3**	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OET106 ELECTRICAL MAINTENANCE AND SAFETY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental principles of electrical safety, including causes and prevention of electrical shocks.
- To develop knowledge of safety protocols and best practices during the installation, testing, commissioning, operation, and maintenance of electrical systems in different settings, including hazardous areas.
- To gain awareness of fire safety measures, including the proper selection and use of fire extinguishers.

UNIT I INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION **9**

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shop.

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UNIT II ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS **9**

Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT III ELECTRICAL SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE **9**

Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.

UNIT IV ELECTRICAL SAFETY IN HAZARDOUS AREAS **9**

Hazardous zones –class 0, 1 and 2 spark, flashovers and corona discharge and functional requirements Specifications of electrical plants, equipment's for hazardous locations Classification of equipment enclosure for various hazardous gases and vapours classification of equipment/enclosure for hazardous locations.

UNIT V FIRE EXTINGUISHERS **9**

Fundamentals of Fire-Initiation of Fires, Types; Extinguishing Techniques, Prevention of Fire, Types of Fire Extinguishers, Fire Detection and Alarm System, CO2 and Halogen Gas Schemes, Foam Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Apply the Electrical Safety Principles.
CO2: Explain Safe Electrical Installations and Maintenances.
CO3: Manage Electrical Safety in Hazardous and Special Areas.
CO4: Promote Safety During Electrical Operations and Repairs.
CO5: Implement Fire Safety and Extinguishing Measures.

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TEXT BOOKS

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. www.apeasternpower.com/downloads/elecact2003.pdf .
3. Gupta, B.R., Handbook of Electrical Power System and Wiring, S. Chand Publishing, 2013.

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REFERENCE BOOKS

1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
2. John Codick, "Electrical safety hand book", Mc Graw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
4. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.
5. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO2	3	3	-	-	3	-	2	1	-	2	-	-	-	-
CO3	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO4	3	-	-	-	-	-	2	1	-	2	-	-	-	-
CO5	3	-	-	-	-	-	2	1	-	2	-	-	-	-
AVG	**3**	**3**	**-**	**-**	**3**	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMT201 BIOENERGY CONVERSION TECHNOLOGIES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To elucidate on biomass, types, availability, and characteristics.
- To gain knowledge on gasification process.
- To gain knowledge on liquidation process.

UNIT I INTRODUCTION **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies.

UNIT II BIOMETHANATION **9**

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT III COMBUSTION **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion.

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UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification - types – comparison – typical application – performance evaluation –economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonization.

UNIT V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1:Estimate the surplus biomass availability of any given area.

CO2:Design a biogas plant for a variety of biofuels.

CO3:Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

CO4:Analyse the influence of process governing parameters in thermochemical conversion of biomass.

CO5:Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021).
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).
3. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, Fundamentals and Applications of Renewable Energy, Indian Edition, Graw Hill; First edition 2020.

REFERENCE BOOKS

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S.
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986.
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981.

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Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2.4	2	-	-	-	-	-	-	-	-	-	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMT202 AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To study the functional requirements of engine components and suitable materials.
- To learn to design of cylinder and piston components.
- To learn to design of connecting rod and crank shaft.

UNIT I FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS **9**

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT II DESIGN OF CYLINDER AND PISTON COMPONENTS **9**

Design of connecting rod – Shank design – small end design – big end design – bolts design, Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT III DESIGN OF CONNECTING ROD AND CRANK SHAFT **9**

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT IV DESIGN OF FLYWHEEL AND VALVE TRAIN **9**

Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.

UNIT V ENGINE TESTING **9**

Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer – Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO2 - HC.-Particle counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1:Discuss the requirements of engine components and select suitable materials.

CO2:Apply the concept of design to cylinder and piston components and solve problems.

CO3:Apply the concept of design to Connecting rod and crank shaft and solve problems.

CO4:Apply the concept of design to flywheel and valve train and solve problems.

CO5:Discuss engine teste cycles, dynamometer and emission measurement technologies and Instruments.

TEXT BOOKS

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. Giancarlo Genta and Lorenzo Morello, The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) , 2019.
3. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.

REFERENCE BOOKS

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

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	2	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	2	-	-	-	-	-	-	-	2	-	-
AVG	**3**	**2.8**	**2.4**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMT203 GREEN MANUFACTURING DESIGN AND PRACTICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.

UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT **9**

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle.

UNIT II AIR POLLUTION SAMPLING **9**

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation- the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone.

UNIT III NOISE POLLUTION AND CONTROL **9**

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT IV WATER DEMAND AND WATER QUALITY **9**

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT V GREEN CO-RATING **9**

Ecological Footprint - Need for Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co- Benefits – Case Studies Of Green Co- Rating.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1:Explain the environmental design and selection of eco-friendly materials.

CO2:Analyse manufacturing processes towards minimization or prevention of air pollution.

CO3:Analyse manufacturing processes towards minimization or prevention of noise pollution.

CO4:Analyse manufacturing processes towards minimization or prevention of water pollution.

CO5:Evaluate green co-rating and its benefits.

TEXT BOOKS

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010.
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.
3. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010.

REFERENCE BOOKS

1. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
2. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.
4. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
5. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-
AVG	**2**	**2**	**2**	-	-	-	-	-	-	-	-	-	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMT204 SEMICONDUCTOR MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To provide the students with a comprehensive understanding of the fundamental principles of semiconductor materials, devices and technology.
- To explore the operational principles of various semiconductor devices, processes involved in the fabrication.
- Apply their knowledge in designing and analyzing basic semiconductor circuits and systems.

UNIT I INTRODUCTION TO SEMICONDUCTOR MATERIALS **9**

Definition and types, comparison with conductors and insulators; bonding and structure - crystal structure (diamond, zinc blende), covalent bonding in semiconductors; energy bands – energy band theory, conduction and valence bands, bandgap and its significance; carrier statistics – electrons and holes, effective mass, fermi level and its significance.

UNIT II SEMICONDUCTOR DEVICES AND THEIR OPERATION **9**

P-N junction – formation and properties, depletion region, forward and reverse bias characteristics; diodes – types and applications; bipolar junction transistors – structure and operation, current gain, common configurations; Field effect transistor – JFETs and MOSFETs, threshold voltage and I-V characteristics, applications.

UNIT III FABRICATION TECHNIQUES **9**

Crystal growth and wafer preparation – czochralski process, wafer slicing and polishing; oxidation – thermal oxidation process, properties of silicon dioxide; photolithography – photoresist application, exposure and development; etching and doping – wet and dry etching techniques, diffusion and ion implantation; thin film deposition – chemical vapor deposition and physical vapor deposition; fabrication for ceramic components – tapecasting, sintering, machining , challenges in processing ceramic materials, integration with semiconductor fabrication process.

UNIT IV CHARACTERIZATION AND TESTING OF SEMICONDUCTORS **9**

Electrical characteristics – I-V and C-V measurements, carrier lifetime and mobility; Optical characterization – photoluminescence and Raman spectroscopy, absorption and reflection measurements; structural characterization – x-ray diffraction, SEM, TEM; Reliability and Failure analysis – stress testing, common failure mechanisms, techniques for failure analysis; characterization of ceramic materials – mechanical testing, thermal properties, electrical properties.

UNIT V CERAMICS IN SEMICONDUCTOR TECHNOLOGY **9**

Overview of applications in semiconductor devices and fabrication processes, comparison with other materials used in semiconductors; ceramic substrates – types of substrates, properties and advantages of ceramic substrates, applications in power electronics, RF components and high frequency devices; ceramic packaging – importance of packaging in semiconductor devices,

types of ceramic packaging, advantages, thermal management and reliability; ceramic s in MEMs – role of ceramics in MEMs, common materials and applications; ceramic dielectrics – types of ceramic dielectric materials, properties and applications, role of high k dielectrics for advanced semiconductor devices

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Apply the fundamental concepts of semiconductor physics.
CO2: Analyze and describe the operation of various semiconductor devices.
CO3: Acquire knowledge of the key processes in semiconductor device fabrication.
CO4: Evaluate the properties and performance of semiconductor materials and devices.
CO5: Use of ceramics in semiconductor technology including advancements in materials and fabrication techniques.

TEXT BOOKS

1. Peter Y Yu, Manuel Cardona, "Fundamentals of Semiconductors: Physics and Material Properties", 1995.
2. Dieter K Schroder, "Semiconductor Material and Device Characterization", 2006.
3. Donald A Neamen, "Semiconductor Physics and Devices", McGraw-Hill, 2002.

REFERENCE BOOKS

1. Adel S Sedra, Kenneth C Smith, "Microelectronic Circuits", OUP USA, 2003.
2. Ben G Streetman, Sanjay Banerjee, "Solid State Electronic Devices", Pearson Education, 2015.
3. Stephen A Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford Univ Press, 2001.
4. Hong Xiao, "Introduction to Semiconductor Manufacturing Technology", Pearson Education, 2000.
5. C Barry Carter, M Grant Norton, " Ceramic Materials: Science and Engineering", 2019.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	3	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	1	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	1	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	1	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	1	-
AVG	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1-Low, 2-Medium, 3-High, "-" – No correlation

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24OMT205 FUTURE ENERGY RESOURCES AND MOBILITY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To expose the students to various future energy resources and mobility.
- To explore the various bio, solar, wind, fuel cell energy technologies.
- To study the various types of energy storage devices and technologies and them comparison.

UNIT I CURRENT AND FUTURISTIC ENERGY RESOURCES **9**

High Carbon Fuels - Gasoline and Diesel Fuels. Low Carbon Fuels – Ethanol, Methanol, Isobutanol, Dimethyl Ether(DME), Polyoxymethylene Dimethyl Ether (PODE), Compressed and Liquified Natural Gas (CNG & LNG). Zero Carbon Fuels – Hydrogen and Ammonia Fuels. – Physiochemical Properties – Improvements in Fuel Quality as per BS Norms – Current and Future plans on storage and distribution infrastructures.

UNIT II ALTERNATE ENERGY RESOURCES **9**

Fuel Cell stacks – Types – Working, Batteries – Types – Working – Materials, Comparison of Fuel Cell and Battery. Future scopes in Fuel Cell and Batteries.

UNIT III CURRENT AND FUTURE INTERNAL COMBUSTION ENGINES (ICE) FOR MOBILITY **9**

BSVI Qualified ICE Powered Vehicles and Technologies, Conventional Hybrid Vehicle Technologies, Advanced Combustion Mode enabled ICEs and Hybrids, Hydrogen and Ammonia Fuelled ICEs, Flexi Fuel Engines. Low Carbon Fuelled ICEs. Decarbonisation and De- fossilization.

UNIT IV ALTERNATE ENERGY RESOURCES POWERED MOBILITY **9**

Fuel Cell Powered Vehicle Technologies, Battery Powered Electric Vehicle Technologies, Requirements of fueling and charging Infrastructures, Comparison of Merits and Demerits, Life cycle analysis and Carbon credit gained between Alternate and Conventional Fuel powered mobility.

UNIT V DATA ANALYSIS OF CURRENT AND FUTURE MOBILITY APPLICATIONS **9**

Case studies in present and future technologies in mobility design and its performance analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1:Explain the impact of high and low carbon energy resource on mobility.
CO2:Synergetic knowledge on fuel cells Battery energy sources.
CO3:Discuss on conventional and future propulsion system.
CO4:Enumerate alternate energy sources powered mobility.
CO5:Perform data analysis of conventional and future propulsion systems.

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TEXT BOOKS

1. Pundir B.P. "I.C. Engines Combustion and Emission", Narosa Publishing House, 2010.
2. Barclay F.J., "Fuel Cells, Engines and Hydrogen", Wiley, 2009.
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2005.

REFERENCE BOOKS

1. Rakesh_Kumar_Maurya Characteristics and Control of Low Temperature Combustion Engines, Springer - ISSN 0941-5122 ISSN 2192-063X.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons 1998.
4. HCCI and CAI Engines – Nptel - https://nptel.ac.in/courses/112104033/33.
5. HCCI Diesel Engines - Nptel - https://nptel.ac.in/courses/112104033/34.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2.4	2	-	-	-	-	-	-	-	-	-	-	-

1-Low, 2-Medium, 3-High, "-" – No correlation

24OMT206 FAILURE ANALYSIS AND NDT TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understating the importance of failure analysis.
- To study the causes of failures, principles of NDT methods.
- To gain knowledge on various test methods.

UNIT I INTRODUCTION TO FAILURE ANALYSIS **9**

Need and scope of failure analysis. Engineering Disasters in history and their failure analysis. Sources of failures. Description & origin of Processing defects. Types of failures- Ductile & Brittle, Fracture Analysis, FMEA. Application of fracture mechanics concepts to design for safety. NDT for failure analysis- an overview.

UNIT II DYE PENETRANT & MAGNETIC PARTICLE INSPECTION 9

Importance of NDT, Visual Inspection: Tools, applications and limitations, Liquid Penetrant Inspection (LPI): Principles, Requisites of a good penetrant and developer, Types of penetrants and developers, Techniques, procedures, interpretation and evaluation of penetrant test indications, advantages, and limitations, case study. Magnetic Particle Inspection (MPI): Principles, Magnetization- Methods, techniques. Continuous & Residual testing of MPI, System sensitivity, Interpretation of MPI indications, Advantages and limitations, case study.

UNIT III ULTRASONIC TESTING 9

Principle, type of Ultrasonic waves, mode conversion in ultrasonics, Principle, UT testing methods: Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, Ultrasonic Testing Techniques: Resonance testing, Through transmission technique, Pulse echo testing technique, Instruments used in UT, Transducer types, Reference blocks with artificially created defects, Calibration of equipment, A-Scan, B-scan & C-scan, case study.

UNIT IV EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy current Testing: Principles, Physics aspects of ECT- conductivity, permeability, resistivity, inductance, inductive reactance, impedance, Filed factor and lift-off effect, edge effect, end effect, Depth of penetration of ECT, Instrumentation, application of ECT, advantages, limitations, case study. Thermography: Principles, Contact and non-contact inspection methods, Heat sensitive paints and papers, thermally quenched phosphors, Liquid crystals, techniques for applying liquid crystals, advantage and limitations, Infrared radiation and infrared detectors, applications, case study.

UNIT V RADIOGRAPHY TESTING 9

Principle, electromagnetic radiation sources, X-ray sources, Production of X-rays, High energy X-ray source, Gama ray source, Properties of X-rays and gamma rays, Inspection techniques, Exposure, Real-time radiography, Films and screens used in radiography, Quality of radiographic film processing, interpretation, evaluation of test results, Computed Tomography, Safety aspects required in radiography, Applications, advantages and limitations, case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1:Discuss on the various failures, their analysis and their importance.

CO2:Adapt the Penetrant testing procedures for evaluating the surface defects.

CO3:Interpret the images and the results obtained from the Thermographic technique and the Eddy current testing.

CO4:Describe the testing procedure and analyze the results obtained in the Ultrasonic inspection.

CO5:Explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

TEXT BOOKS

1. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17, 2000.
3. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

REFERENCE BOOKS

1. ASM International, ASM Handbook, Volume 17: Nondestructive Evaluation of Materials, 2018.
2. B. Hull and V. John, Non-Destructive Testing. New York, NY, USA: Springer, 2012.
3. N. Ida, C. Boller, and R. Diederichs, Eds., Handbook of Advanced Nondestructive Evaluation, 2nd ed. Cham, Switzerland: Springer, 2023.
4. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2021.
5. G. Lacidogna, Ed., Nondestructive Testing (NDT). Basel: MDPI, 2021.

Mapping of COs with POs and PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	2	-	-	-	-	-	-	-	-	1	-
CO2	3	-	2	2	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	1	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-	1	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	1	-
AVG	**3**	**2**	**2**	**2**	-	-	-	-	-	-	-	-	**1**	-

1-Low, 2-Medium, 3-High, "-" – No correlation

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