



SRI SHAKTHI

INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Coimbatore - 62.



DEPARTMENT OF BIOMEDICAL ENGINEERING



CURRICULA AND SYLLABI
B.E BIOMEDICAL ENGINEERING



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SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTE)
COIMBATORE – 641 062
REGULATION 2019
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS
B.E. BIOMEDICAL ENGINEERING



VISION OF THE INSTITUTE

To make the institution one of our nation's great engineering schools, recognized nationally and internationally for excellence in teaching, research and public service. We seek to be the preferred destination for students, practitioners seeking an engineering education, employers hiring engineering graduates and organizations seeking engineering knowledge

MISSION OF THE INSTITUTE

To provide an encouraging environment to develop the intellectual capacity, critical thinking, creativity and problem solving ability of the students

VISION OF THE DEPARTMENT

To develop the Department of Biomedical Engineering into globally recognized centre for quality education and innovative research to provide better health care service to the society.

MISSION OF THE DEPARTMENT

- To achieve the academic distinction on par with technological development to face the challenges in the health care industries
- To empower the students for higher education by inculcating research interest
- Transfer of biomedical engineering research into applications to enhance employment and entrepreneurship
- To understand the ethical, social and economic implications of their research and innovation on the society



PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1	:	Knowledge advancement - To pertain core foundation in life science and knowledge acquired in engineering to solve the complex biomedical problems and challenges.
PEO2	:	Career Achievements – To design and develop medical equipment with global standards and economically viable for the society
PEO3	:	Professional Achievement- To espouse professional success, infuse ethical values, team spirit, communication skills and leadership for promoting industrial interest among students to meet societal issues.
PEO4	:	Life-long Learning – To conduit the gap between engineering and medicine, sustaining and expanding their technical competence and engage in learning opportunities throughout their careers

PROGRAMME OUTCOMES:

Engineering Graduates will be able to:

PO1	A	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	B	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
PO3	C	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
PO4	D	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
PO5	E	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.
PO6	F	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
PO7	G	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.
PO8	H	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	I	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	J	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.
PO11	K	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.
PO12	L	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change



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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	To design, develop, analyze and test analytical and theragnostics instruments/ equipments that resolve the societal healthcare problems by applying the concepts of Life sciences, Engineering and Technology.
PSO2	To develop health care information system for medical automation using Robotics, embedded system, Internet of Things, Artificial Intelligence, Machine learning and data analysis.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓	✓						
3						✓	✓	✓	✓	✓	✓	
4						✓						✓

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAMME SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	✓	✓	✓		✓	✓	✓	✓	✓		✓	
2	✓	✓	✓	✓	✓	✓	✓		✓			✓



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MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

A broad relation between the Course Outcomes and Programme Outcomes is given in the following table

COURSE OUTCOMES		PROGRAM OUTCOMES												
SEM	COURSE NAME	A	B	C	D	E	F	G	H	I	J	K	L	
I	Communicative English									✓	✓	✓	✓	
	Matrices and Calculus for Biomedical Engineering	✓	✓	✓									✓	
	Applied Physics For Biosciences	✓	✓	✓				✓					✓	
	Computational Thinking and Problem Solving	✓	✓	✓	✓	✓							✓	
	Anatomy and Human Physiology	✓	✓	✓										
	Language – Tamil Language – Malayalam										✓	✓	✓	✓
	Language- Foundation English													
	Crop Production Laboratory – I	✓						✓		✓				
	Communicative English Laboratory										✓	✓	✓	✓
	Computational Thinking and Problem Solving Laboratory	✓	✓	✓										✓
	Anatomy and Human Physiology Laboratory	✓	✓	✓										✓
	Applied Physics For Biosciences Laboratory	✓	✓	✓					✓					✓
	Engineering Exploration- I	✓	✓	✓	✓	✓	✓							
II	English for Engineers									✓	✓	✓	✓	
	Laplace Transforms and Advanced Calculus for Biomedical Engineering	✓	✓	✓									✓	
	C programming	✓	✓	✓	✓	✓							✓	



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	Medical Physics	✓	✓	✓					✓											
	Biochemistry	✓	✓	✓					✓										✓	
	Pathology and Microbiology	✓	✓	✓	✓	✓														
	English for Engineers Laboratory	✓	✓	✓																
	C programming Laboratory	✓	✓	✓	✓	✓													✓	
	Biochemistry Laboratory	✓	✓	✓					✓										✓	
	Pathology and Microbiology Laboratory	✓	✓	✓																
	Engineering Exploration- II	✓	✓	✓	✓	✓	✓													
III	Transforms and Partial Differential Equations for Biomedical Engineering	✓	✓	✓																
	Biosignals and systems	✓	✓	✓	✓	✓														
	Electron Devices and Biocircuits	✓	✓	✓	✓	✓														
	Biomedical Instrumentation –I	✓	✓	✓	✓	✓														
	Biosensors and Transducers	✓	✓	✓	✓															
	Tissue Engineering	✓	✓	✓	✓	✓														
	Career Enhancement Program I	✓	✓	✓	✓	✓														
	Electron Devices and Biocircuits Laboratory	✓	✓	✓	✓	✓														✓
	Biomedical Instrumentation- I Laboratory	✓	✓	✓	✓															
	Biosensors and Transducers Laboratory	✓	✓	✓	✓															
	Engineering Exploration- III	✓	✓	✓	✓	✓	✓													
IV	Random Processes and Statistics	✓	✓	✓	✓					✓										
	Biosignal Processing	✓	✓	✓	✓	✓														
	Biocircuit Analysis	✓	✓	✓	✓	✓														✓
	Biomedical Instrumentation –II	✓	✓	✓	✓															
	Radiological Equipments	✓	✓	✓																
	Environmental Science for Biomedical Engineers	✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Career Enhancement Program II	✓	✓	✓															
	Embedded design for Biomedical Engineering	✓	✓	✓		✓													
	Biosignal Processing Laboratory	✓	✓	✓	✓	✓													
	Biocircuit Analysis Laboratory	✓	✓	✓	✓	✓													✓
	Biomedical Instrumentation -II Laboratory	✓	✓	✓	✓														
	Engineering Exploration – IV	✓	✓	✓	✓	✓	✓												
V	Biomedical Image Processing	✓	✓	✓	✓	✓													
	Biocontrol System	✓	✓	✓															
	Digital Principles in Microprocessor and Microcontroller	✓	✓	✓	✓	✓													
	Regulatory Control Boards for Biomedical Devices	✓	✓	✓	✓	✓													
	Integrated Circuits for Biomedical Instrumentation	✓	✓	✓		✓													
	Career Enhancement Program III	✓	✓	✓															
	Biomedical Image Processing Laboratory	✓	✓	✓	✓	✓													
	Digital Principles in Microprocessor and Microcontroller Laboratory	✓	✓	✓	✓	✓													
	Integrated Circuits for Biomedical Instrumentation Laboratory	✓	✓	✓		✓													
	Engineering Exploration- V	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓		
	Internet of Things	✓	✓	✓	✓														
VI	Medical Assist Devices	✓	✓	✓	✓														
	Advanced Biomedical Equipments	✓	✓	✓	✓														
	Career Enhancement Program IV	✓	✓	✓										✓	✓	✓	✓		
	Mini Project	✓	✓	✓	✓	✓	✓												
	Medical Assist Devices Laboratory	✓	✓	✓	✓														
	Advanced Biomedical Equipments Laboratory	✓	✓	✓	✓														

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I - VIII SEMESTERS CURRICULA AND SYLLABI

INDUCTION PROGRAM

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19ENTL101T	Communicative English	HS	3	2	0	0	2
2	U19MATH102	Matrices and Calculus for Biomedical Engineering	BS	5	3	1	0	4
3	U19PHTL102T	Applied Physics for Biosciences (Common for BT & BME)	BS	3	2	0	0	2
4	U19CSTL101T	Computational Thinking and Problem Solving	ES	4	3	0	0	3
5	U19BMTL101T	Anatomy and Human Physiology	PC	4	3	0	0	3
6	U19LATH101 U19LATH102 U19LAEN101	Language - Tamil Language - Malayalam Language-Foundation English	HS	3	2	0	0	2
PRACTICALS								
7	U19AEPC101	Crop Production Laboratory - I	BS	5	0	0	4	2
8	U19ENTL101L	Communicative English Laboratory	HS	3	0	0	2	1
9	U19CSTL101L	Computational Thinking and	ES	3	0	0	2	1



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		Problem Solving Laboratory						
10	U19BMTL101L	Anatomy and Human Physiology Laboratory	PC	3	0	0	2	1
11	U19PHTL102L	Applied Physics for Biosciences Laboratory (Common for BT & BME)	BS	3	0	0	2	1
12	U19CCEX101	Engineering Exploration- 1	EEC	3	1	0	2	2
TOTAL				42	16	1	14	24

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19ENTL202T	English for Engineers	HS	3	2	0	0	2
2	U19MATH211	Laplace Transforms and Advanced Calculus for Biomedical Engineering	BS	5	3	1	0	4
3	U19CSTL203T	C programming	ES	4	3	0	0	3
4	U19BMTH201	Medical Physics	PC	4	2	1	0	3
5	U19BMTL202T	Biochemistry	PC	4	3	0	0	3
6	U19BMTL203T	Pathology and Microbiology	PC	4	3	0	0	3
PRACTICALS								
7	U19ENTL202L	English for Engineers Laboratory	HS	3	0	0	2	1
8	U19CSTL203L	C programming Laboratory	ES	3	0	0	2	1
9	U19BMTL202L	Biochemistry Laboratory	PC	3	0	0	2	1
10	U19BMTL203L	Pathology and Microbiology Laboratory	PC	3	0	0	2	1

11	U19CCEX202	Engineering Exploration- II	EEC	3	1	0	2	2
TOTAL				39	17	2	10	24

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19MATH320	Transforms and Partial Differential Equations for Biomedical Engineering	BS	5	3	1	0	4
2	U19BMTH302	Biosignals and systems	ES	4	3	0	0	3
3	U19BMTL304T	Electron Devices and Biocircuits	ES	4	3	0	0	3
4	U19BMTL305T	Biomedical Instrumentation -I	PC	4	3	0	0	3
5	U19BMTL306T	Biosensors and Transducers	PC	4	3	0	0	3
6	U19BMTH303	Tissue Engineering	PC	4	3	0	0	3
PRACTICALS								
7	U19CCLC301	Career Enhancement Program I	EEC	2	0	0	2	1
8	U19BMTL304L	Electron Devices and Biocircuits Laboratory	ES	3	0	0	2	1
9	U19BMTL305L	Biomedical Instrumentation- I Laboratory	PC	3	0	0	2	1
10	U19BMTL306L	Biosensors and Transducers Laboratory	PC	3	0	0	2	1
11	U19CCEX303	Engineering Exploration- III	EEC	3	0	0	2	1
TOTAL				39	18	1	10	24



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SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19MATH427	Random Processes and Statistics	BS	4	3	0	0	3
2	U19BMTL407T	Biosignal Processing	PC	4	3	0	0	3
3	U19BMTL408T	Biocircuit Analysis	PC	4	3	0	0	3
4	U19BMTL409T	Biomedical Instrumentation -II	PC	4	3	0	0	3
5	U19BMTH404	Radiological Equipments	PC	4	3	0	0	3
6	U19BMTH405	Environmental Science for Biomedical Engineers	HS	4	3	0	0	3
PRACTICALS								
7	U19CCLC402	Career Enhancement Program II	EEC	2	0	0	2	1
8	U19ECLC404	Embedded design for Biomedical Engineering	ES	4	0	0	4	2
9	U19BMTL407L	Biosignal Processing Laboratory	PC	3	0	0	2	1
10	U19BMTL408L	Biocircuit Analysis Laboratory	PC	3	0	0	2	1
11	U19BMTL409L	Biomedical Instrumentation -II Laboratory	PC	3	0	0	2	1
12	U19CCEX404	Engineering Exploration - IV	EEC	3	0	0	2	1
TOTAL				50	24	0	14	25

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19BMTL510T	Biomedical Image Processing	PC	4	3	0	0	3
2	U19BMTH508	Biocontrol System	PC	4	2	1	0	3
3	U19ECTL511T	Digital Principles in Microprocessor and Microcontroller	ES	4	3	0	0	3
4	U19BMTH509	Regulatory Control Boards for Biomedical Devices	PC	4	3	0	0	3
5	U19BMTL511T	Integrated Circuits for Biomedical Instrumentation	ES	4	3	0	0	3
6		Professional Elective I	PE	4	3	0	0	3
PRACTICALS								
7	U19CCLC503	Career Enhancement Program III	EEC	2	0	0	2	1
8	U19BMTL510L	Biomedical Image Processing Laboratory	PC	3	0	0	2	1
9	U19ECTL511L	Digital Principles in Microprocessor and Microcontroller Laboratory	ES	3	0	0	2	1
10	U19BMTL511L	Integrated Circuits for Biomedical Instrumentation Laboratory	ES	3	0	0	2	1
11	U19CCEX505	Engineering Exploration- V	EEC	3	0	0	2	1



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12	U19BMLC501	Internet of Things	PC	3	0	0	2	1
TOTAL				41	17	1	12	24

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19BMTL612T	Medical Assist Devices	PC	4	3	0	0	3
2	U19BMTL613T	Advanced Biomedical Equipments	PC	4	3	0	0	3
3		Professional Elective- II	PE	4	3	0	0	3
4		Professional Elective- III	PE	4	3	0	0	3
5		Professional Elective- IV	PE	4	3	0	0	3
6		Open Elective- I	OE	4	3	0	0	3
PRACTICALS								
7	U19CCLC604	Career Enhancement Program IV	EEC	2	0	0	2	1
8	U19BMPR601	Mini Project	EEC	6	0	0	4	2
9	U19BMTL612L	Medical Assist Devices Laboratory	PC	3	0	0	2	1
10	U19BMTL613L	Advanced Biomedical Equipment Laboratory	PC	3	0	0	2	1
TOTAL				38	18	0	10	23



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SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	U19BMTH710	Biomechanics	PC	4	3	0	0	3
2	U19BMTH711	Hospital Waste Management	PC	4	3	0	0	3
3		Professional Elective- V	PE	4	3	0	0	3
4		Open Elective-II	OE	4	3	0	0	3
PRACTICALS								
5	U19BMLC702	Hospital Training	EEC	6	0	0	4	2
6	U19BMPR702	Project Work-Phase I	EEC	6	0	0	4	2
TOTAL				28	12	0	8	16

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	U19BMPR803	Project Work-Phase II	EEC	18	0	0	12	6
TOTAL				18	0	0	12	6

HUMANITIES AND SOCIALSCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19ENTL101	Communicative English	HS	3	2	0	0	2
2	U19LATH101 U19LATH102	Language - Tamil Language – Malayalam	HS	3	2	0	0	2
3	U19ENTL101	Communicative English Laboratory	HS	3	0	0	2	1
4	U19ENTL202T	English for Engineers	HS	3	2	0	0	2
5	U19ENTL202L	English for	HS	3	0	0	2	1



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6		Engineers Laboratory						
	U19BMT1405	Environmental Science for Biomedical Engineers	HS	4	3	0	0	3

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19MATH102	Matrices and Calculus for Biomedical Engineering	BS	5	3	1	0	4
2	U19PHTL104	Physics For Biosciences	BS	3	2	0	0	2
3	U19PHTL104	Physics For Biosciences Laboratory	BS	3	0	0	2	1
4	U19AEPC101	Crop Production Laboratory – I	BS	5	0	0	4	2
5	U19MATH211	Laplace Transforms and Advanced Calculus for Biomedical Engineers	BS	5	3	1	0	4
6	U19MATH320	Transforms and Partial Differential Equations for Biomedical Engineering	BS	5	3	1	0	4
7	U19MATH427	Random Processes and Statistics	BS	4	3	0	0	3

ENGINEERING SCIENCES (ES)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19CSTL103T	Computational	ES	4	3	0	0	3



		Thinking and Problem Solving						
2	U19CSTL103L	Computational Thinking and Problem Solving Laboratory	ES	3	0	0	2	1
3	U19CSTL203T	C programming	ES	4	3	0	0	3
4	U19CSTL203L	C programming Laboratory	ES	3	0	0	2	1
5	U19BMTH302	Biosignals and systems	ES	4	3	0	0	3
6	U19BMTL304T	Electron Devices and Biocircuits	ES	4	3	0	0	3
7	U19BMTL304L	Electron Devices and Biocircuits Laboratory	ES	3	0	0	2	1
8	U19ECLC404	Embedded design for Biomedical Engineering	ES	4	0	0	4	2
9	U19ECTL511T	Digital Principles in Microprocessor and Microcontroller	ES	4	3	0	0	3
10	U19BMTL511T	Integrated Circuits for Biomedical Instrumentation	ES	4	3	0	0	3
11	U19ECTL511L	Digital Principles in Microprocessor and Microcontroller Laboratory	ES	3	0	0	2	1
12	U19BMTL511L	Integrated Circuits for Biomedical Instrumentation Laboratory	ES	3	0	0	2	1



PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMTL101T	Anatomy and Human Physiology	PC	4	3	0	0	3
2	U19BMTL101L	Anatomy and Human Physiology Laboratory	PC	3	0	0	2	1
3	U19BMTL202T	Biochemistry	PC	4	3	0	0	3
4	U19BMTL203T	Pathology and Microbiology	PC	4	3	0	0	3
5	U19BMTH201	Medical Physics	PC	4	2	1	0	3
6	U19BMTL202L	Biochemistry Laboratory	PC	3	0	0	2	1
7	U19BMTL203L	Pathology and Microbiology Laboratory	PC	3	0	0	2	1
8	U19BMTL305T	Biomedical Instrumentation -I	PC	4	3	0	0	3
9	U19BMTL306T	Biosensors and Transducers	PC	4	3	0	0	3
10	U19BMTH303	Tissue Engineering	PC	4	3	0	0	3
11	U19BMTL305L	Biomedical Instrumentation -I Laboratory	PC	3	0	0	2	1
12	U19BMTL306L	Biosensors and Transducers Laboratory	PC	3	0	0	2	1
13	U19BMTL407T	Biosignal Processing	PC	4	3	0	0	3
14	U19BMTL409T	Biomedical Instrumentation -II	PC	4	3	0	0	3
15	U19BMTH404	Radiological Equipments	PC	4	3	0	0	3
16	U19BMTH406	Biology for Electronics Engineers (ECE & EEE)	PC	4	3	0	0	3
17	U19BMTH407	Biology for Mechanical	PC	4	3	0	0	3



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		Engineers						
18	U19BMTL407L	Biosignal Processing Laboratory	PC	3	0	0	2	1
19	U19BMTL409L	Biomedical Instrumentation -II Laboratory	PC	3	0	0	2	1
20	U19BMTL408T	Biocircuit Analysis	PC	4	3	0	0	3
21	U19BMTL408L	Biocircuit Analysis Laboratory	PC	3	0	0	2	1
22	U19BMTL510T	Biomedical Image Processing	PC	4	3	0	0	3
23	U19BMTH509	Biocontrol System	PC	4	3	0	0	3
24	U19BMTH510	Regulatory Control Boards for Biomedical Devices	PC	4	3	0	0	3
25	U19BMTL510L	Biomedical Image Processing Laboratory	PC	3	0	0	2	1
26	U19BMLC501	Internet of Things	PC	3	0	0	2	1
27	U19BMTL612T	Medical Assist Devices	PC	4	3	0	0	3
28	U19BMTL613T	Advanced Biomedical Equipment	PC	4	3	0	0	3
29	U19BMTL612L	Medical Assist Devices Laboratory	PC	3	0	0	2	1
30	U19BMTL613L	Advanced Biomedical Equipment Laboratory	PC	3	0	0	2	1
31	U19BMTH710	Biomechanics	PC	4	3	0	0	3
32	U19BMTH711	Hospital Waste Management	PC	4	3	0	0	3



PROFESSIONAL ELECTIVES (PE)

SEMESTER V

PROFESSIONAL ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMPE001	3D printing and artificial organs	PE	4	3	0	0	3
2	U19BMPE002	Robotics for medical applications	PE	4	3	0	0	3
3	U19BMPE003	Augmented reality and virtual reality in medicine	PE	4	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMPE004	BioMEMS	PE	4	3	0	0	3
2	U19BMPE005	Nanotechnology and Nanomedicine	PE	4	3	0	0	3
3	U19BMPE006	Drug Delivery systems	PE	4	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMPE007	Medical Optics	PE	4	3	0	0	3
2	U19BMPE008	Modelling of Physiological System	PE	4	3	0	0	3
3	U19BMPE009	Biometric Systems	PE	4	3	0	0	3



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SEMESTER VI
PROFESSIONAL ELECTIVE IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMPE010	Body Area Networks and Mobile Health Care	PE	4	3	0	0	3
2	U19BMPE011	Medical informatics	PE	4	3	0	0	3
3	U19BMPE012	Biomaterials	PE	4	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMPE013	Intellectual Property Rights	PE	4	3	0	0	3
2	U19BMPE014	Medical Ethics	PE	4	3	0	0	3
3	U19BMPE015	Thermal Imaging	PE	4	3	0	0	3

OPEN ELECTIVES (OE)

SEMESTER VI
OPEN ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMOE001	Bio Healthcare and Telemedicine	OE	4	3	0	0	3
2	U19BMOE002	Embedded Systems in Medical Devices	OE	4	3	0	0	3

**SEMESTER VII
OPEN ELECTIVE II**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BMOE003	Hospital Management system	OE	4	3	0	0	3
2	U19BMOE004	Biomedical Instrumentation	OE	4	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19CCEX101	Engineering Exploration- I	EEC	3	1	0	2	2
2	U19CCEX202	Engineering Exploration- II	EEC	3	1	0	2	2
3	U19CCEX303	Engineering Exploration - III	EEC	3	0	0	2	1
4	U19CCLC301	Career Enhancement Program-I	EEC	2	0	0	2	1
5	U19CCEX404	Engineering Exploration - IV	EEC	3	0	0	2	1
6	U19CCLC402	Career Enhancement Program-II	EEC	2	0	0	2	1
7	U19CCEX505	Engineering Exploration - V	EEC	3	0	0	2	1
8	U19CCLC503	Career Enhancement Program-III	EEC	2	0	0	2	1
9	U19CCLC604	Career Enhancement Program IV	EEC	2	0	0	2	1
10	U19BMPR601	Mini Project	EEC	6	0	0	4	2
11	U19BMPR702	Project Work-Phase I	EEC	6	0	0	4	2

12	U19BMLC702	Hospital Training	EEC	6	0	0	4	2
13	U19BMPR803	Project Work-Phase II	EEC	18	0	0	12	6



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S.No	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	5	3							8	4.81
2	BS	9	4	4	3					20	12.05
3	ES	4	4	7	2	6				23	13.85
4	PC	4	11	11	18	13	8	3		68	40.96
5	PE					3	9	6		18	10.85
6	OE						3	3		6	3.62
7	EEC	2	2	2	2	2	3	4	6	23	13.86
Total		24	24	24	25	24	23	16	6	166	100
	Non-credit/ Mandatory										



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COURSE OBJECTIVES

- To develop learners' ability to listen and comprehend talks for the application of language in various context.
- To develop the students' ability to use English accurately, appropriately and fluently in different social and professional situations.
- To comprehend advanced technical passages and to identify the author's purpose and tone.
- To enhance advanced level of writing by organizing ideas and achieving consistency in academic as well as workplace contexts.
- To enhance the technical components of English language for formulating effective and appropriate sentences.

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

PREREQUISITES

- Nil

THEORY COMPONENT CONTENTS

UNIT I

BASICS OF GRAMMAR

6

Use of the Gerund - Use of the infinite - 'Used to' for habitual actions - Degrees of Comparison - Reading Comprehension passage and answering- Essay writing ((Narrative / Descriptive / Expository / Persuasive)- Letter Writing (Suggestions / Apology/ Acceptance).

UNIT II

FOCUS ON LANGUAGE DEVELOPMENT

6

Modal verbs (Possibility, ability, Permission, Suggestions and obligations obligation) - Simple Past vs Present Perfect - Subject and verb agreement - Interpreting charts / Graphs / Tables - Instructions.

UNIT III

FUNCTIONAL GRAMMAR AND FORMAL WRITING

6

Relative Pronouns for people and things - Future with 'be going to' and 'will' - Personal and impersonal passive - Email writing - Memo writing - Expansion of a Proverb.

UNIT IV

EXTENDED WRITING

6

Fixed and Semi-fixed expressions - Wishes and hypotheses - Conditional clauses -Process Description- Notice / Agenda / Minutes of Meeting.

Idioms: guessing meaning based on the context - Question-Tags - Reported speech - Technical Proposal – Report Writing (Project / Survey).

Total: 30 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1 Communicate with one or many listeners using appropriate communicative strategies.
- CO2 Speak clearly, confidently and comprehensively using appropriate communicative strategies.
- CO3 Read different genres of texts adopting various reading strategies.
- CO4 Understand the form and function of the basic official correspondences and perform a range official support through formal and informal writings.
- CO5 Comprehend and apply the language learning strategies to read, comprehend, organize and retain written information.

TEXT BOOKS

- T1. Richards, C. Jack. Interchange Students Book-2 New Delhi: CUP, 2015.
- T2. Means, L. Thomas and Elaine Langlois. English and Communication For Colleges. Cengage Learning, USA: 2007.

REFERENCE BOOKS

- R1. Redston, Chris & Gillies Cunningham. Face2Face (Upper-intermediate Student's Book). Cambridge University Press, New Delhi: 2005.
- R2. Daise, Debra & Charl Norloff. Q:Skills for Success Reading and Writing (2nd Edition). Oxford University Press. 2019.
- R3. Sudharshana N Pand Savitha C. English for Technical Communication. Cambridge University Press. 2018.

WEB RESOURCES

- W1. <https://learnenglish.britishcouncil.org/grammar>
- W2. [https://www.kau.edu.sa/Files/0013287/Subjects/academic-writing-handbook-international-students-3rd-ed%20\(2\).pdf](https://www.kau.edu.sa/Files/0013287/Subjects/academic-writing-handbook-international-students-3rd-ed%20(2).pdf)
- W3. https://owl.purdue.edu/owl/general_writing/academic_writing/essay_writing/descriptive_essays.html



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theorem (excluding proof) – Applications of complex integration in Biomedical Engineering.

TOTAL: 60 HOURS

Course outcomes

At the end of the course students should be able to

- CO1** Apply the Laplace transform to solving the differential and integral equations.
- CO2** Apply the principles of partial differentiation to transform a function from one form to another and also to find the optimal values of functions of several variables.
- CO3** Perform vector calculus operations such as gradient, divergence and curl in vector and scalar fields and apply the techniques of line, surface and volume integrals to solve application problems.
- CO4** Gain knowledge to construct the analytic function and to find the image of conformal mapping
- CO5** Integrate knowledge and ideas of complex integration in a coherent and meaningful manner and use appropriate techniques for solving related problems and for establishing theoretical results
- CO6** To understand the basics and importance of laplace transforms, differential calculus of several variables used in Biomedical Engineering.

TEXT BOOKS

1. Grewal.B.S., "HigherEngineering Mathematics", 44thEdition,KhannaPublications, Delhi, 2017.

REFERENCES

1. Bali. N. P and Manish Goyal., "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt Ltd., 2016.
2. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education ,2018.
3. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2015.
4. Peter V. O 'Neil, " Advanced Engineering Mathematics", 7th Edition, Cengage learning India Pvt .,Ltd, New Delhi, 2010.
5. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited ,New Delhi, 2008.



Course Objectives

The students should be made

- To write modular programs consisting of structure, functions and pointer concepts.
- To define the files, file manipulations
- To use structure variables for data storage and manipulation.
- To understand the knowledge about linear data structure

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1									2	2
CO2	2	1	1	1	2								2	1
CO3	3	2	2	1	3								2	1
CO4	3	2	2	1	3								2	2
CO5	2	1	1	1	2								2	2
CO6	2	1	1	1	2								2	2

UNIT I**INTRODUCTION: C PROGRAMMING**

9

Structure of C program, Comments, Data types, Variables, Tokens: Keyword, Identifier, Constants, Operators, Expression and evaluation, Input and Output statements, Decision making-statements, Iterative statements, Storage Classes: auto, register, static and extern, Preprocessor Directives.

UNIT II**ARRAYS AND STRING**

9

Introduction to arrays: Declaration, Initialization. One dimensional array Multi-dimensional arrays, Searching: Linear and Binary Search, Sorting: Bubble sort, Selection Sort. Introduction to string, Built in string functions, String manipulation with and without built in functions, Array of strings, Pattern matching application using strings.

UNIT III**FUNCTIONS AND POINTERS**

9

Introduction to functions, Function prototype, Function definition, Function call, User defined functions and Standard functions (math function), Parameter passing: Call by value, Call by reference, Recursive functions, Passing arrays to functions, Command line arguments. Pointer in C, Importance of pointer, Types of pointer, Pointer expression and arithmetic, Pointer and array, String as pointer, Pointer to function, Dynamic Memory Allocation

UNIT IV**USER DEFINED DATATYPES**

9

Structure: Declaration, Accessing structure elements, Array of structure, Nested structure, Pointers to structure, Structure to function, typedef vs #define. Union: Declaration, Accessing union elements, Difference between structure and union, Enum and its uses



Introduction to file, File Operations: Create, Open: File modes, Read, Write, Move, Close, File Processing: Sequential access and Random access.

TOTAL: 45 HOURS

Course outcomes

At the end of the course students should be able to

- CO1 Explain the syntax for C programming
- CO2 Associate the programs in 'C' for real world situation
- CO3 Apply the concepts of Arrays, Strings in 'C' language for user defined problems.
- CO4 Apply the concept of functions and pointers.
- CO5 Associate the programs with structure using 'C' language.
- CO6 Discuss to read and write data from/to files in 'C' Programs.

TEXT BOOKS

1. Programming in C, Ashok N. Kamthane, 2nd Edition ,Pearson Education India, 2011
2. Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A Structures Programming Approach using C", Third Edition, Cengage Learning, 2006.

REFERENCES

1. A first book of ANSI C by Gray J.Brosin 3rd edition Cengage delmer Learning India P.Ltd
2. Pradip Dey, Manas Ghosh, "Programming in C", second edition, Oxford University Press, 2011.
3. Seyed H Roosta,"Foundations of programming languages design & implementation", Cengage Learning. 2009.



Course Objectives

The students should be made

- To study the characteristics of non-ionizing radiation
- To learn about the physics of ultrasound and its clinical applications
- To understand the phenomenon of radioactive decay and the production of radionuclides
- To know the interaction of radiation with matter and its clinical significance.
- To learn the radiation dosage and its effects

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3					2					2	
CO2	3	3	3					2					2	
CO3	3	2	2					2					2	
CO4	3	3	2					2					2	
CO5	3	3	3					2					2	
CO6	3	3	2					2					2	

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION 9

Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects - Tissue as a leaky dielectric - Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit- limits of vision and color vision an overview, Thermography- Application

UNIT II PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE 9

Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications

UNIT III RADIOACTIVE NUCLIDES 9

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology, Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radionuclide-fission and neutron capture reaction, radionuclide Generator-Technetium generator.

UNIT IV INTERACTION OF RADIATION WITH MATTER 9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.

UNIT V RADIATION DOSE AND ITS EFFECTS 9

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the dosimetric quantities, Radiation biology – effects of radiation, concept of LD



50, Stochastic and Non-stochastic effects, Radiation Syndrome.

TOTAL: 45 HOURS

Course outcomes

At the end of the course students should be able to

- CO1 Explain about the characteristics of non-ionizing radiation and its medical applications
- CO2 Describe the interaction of ultrasound with matter and analyse its medical applications.
- CO3 Assimilate the types of radionuclides and their methods of production.
- CO4 Discuss the interaction of charged particles with matter.
- CO5 Outline the importance of radiation dose and its effects
- CO6 Discuss the effects of ionizing and non-ionizing radiation in human body

TEXT BOOKS

1. B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, D.R. Hose,- Medical Physics and Biomedical Engineering, Institute of physics publishing, Bristol and Philadelphia, 2099. (Unit 1,2,5)
2. Gopal B. Saha- Physics and Radiobiology of Nuclear Medicinel Third edition Springer, 2006. (Unit 2,3,4).

REFERENCES

1. W.J. Meredith and J.B. Massey- Fundamental Physics of Radiology Varghese Publishing house. 2092.
2. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, NewYork, 2010
3. R.S. Khandpur,- Handbook of Biomedical InstrumentationI, Tata McGraw-Hill, New Delhi, 2003.



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Course Objectives

The students should be made

- To study structural and functional properties of biomacromolecules
- To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders related to the abnormalities of these biomolecules

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2				2					1	1	2
CO2	3	3	2				2					1	1	2
CO3	3	3	3				2					1	1	2
CO4	3	3	3				2					1	1	2
CO5	3	3	1				2					1	1	2
CO6	3	3	3				2					1	1	2

UNIT I INTRODUCTION TO BIOCHEMISTRY AND BIOMOLECULES 9

Introduction to biochemistry, biochemistry of living cell, chemical bonds, pH and pKa, Handersen and Hasselbalch equation, acids and bases, buffers, physiological buffers. Energy in living system, determination of change in free energy from equilibrium constant and reduction potential. Introduction to biomolecules and scope of clinical biochemistry.

UNIT II CARBOHYDRATES 9

Classification, physical and chemical properties of carbohydrates- isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose and fructose. Metabolism-glycolysis, citric acid cycle, gluconeogenesis, glycogenesis, glycogenolysis and its biological significance. Hormonal regulation and disorders of carbohydrate metabolism

UNIT III LIPIDS 9

Classification and functions of lipids, cholesterol and steroids, hormones- structure and function. Oxidation and degradation of fatty acids, eicosanoids, cholesterol biosynthesis, lipoproteins, ketonebodies and ketogenesis. Hormonal regulation and disorders of lipid metabolism.

UNIT IV AMINO ACIDS AND PROTEINS 9

Classification of amino acids, essential and non-essential amino acids, metabolism of amino acids- transamination- deamination- metabolism of ammonia- urea cycle. Structure of proteins- primary, secondary, tertiary and quaternary structure and biological significance. Purification of proteins- chromatography and electrophoresis techniques. Enzymes- classification, mechanism of action, inhibition, factors affect enzyme activity, Michals' and Menten's equation of enzyme kinetics

UNIT V NUCLEIC ACIDS 9

Nitrogenous bases - purines and pyrimidines, nucleosides and nucleotides. Structure and classification of nucleic acids- DNA and RNA, biological functions, metabolism of nucleic acids. Hormonal regulation and metabolic disorders.



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Course outcomes

At the end of the course students should be able to

- CO1** Explain the fundamentals of biochemistry and biomolecules.
- CO2** Describe the structure, types, metabolism and disorders of carbohydrates
- CO3** Understand the classification and functions of lipids and disorders of lipid metabolism
- CO4** Analyse the structure, functions of proteins and its purification techniques
- CO5** Understand the Clinical application of Biochemistry
- CO6** Examine structural and functional properties of carbohydrates, lipids and nucleic acids

TEXT BOOKS

1. U. Satyanarayana and U. Chakerapani, Biochemistry, 5th Edition, Books and Allied (P) Ltd., 2017.
2. M. D. Rafi, Text Book of Biochemistry for Medical Students, 2nd Edition, University Press, 2014.
3. Victor. W. Rodwell, David. A. Bender, Kathleen. M. Bothem, Peter. J. Kennelly and P. Anthony Weil, Harper's Illustrated Biochemistry 31st Edition, McGraw Hill Publications, 2020.

REFERENCES

1. David. L. Nelson, Michael. M. Cox, Lehninger Principles of Biochemistry, 7th Edition, 2017.
2. Jeremy. M. Berg, John. L. Tymoczko and L. Stryer, Biochemistry, 6th Edition, W H Freeman and Company, New York, 2006.



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Course Objectives

The students should be made

- To gain a knowledge on the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To solve the clinical problems associated with biomolecules.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			2								3	3
CO2	3	1		1	1								3	3
CO3	3	1		1	2								3	3
CO4	3	2	1		2								3	3
CO5	3	1			1								3	3
CO6	3	1			1								3	3

UNIT I**MICROSCOPES****9**

Microscope- Principles, working mechanism and application - Simple and compound microscope -Dark field -Phase contrast, Fluorescence, SEM and TEM. Staining methods- simple, gram staining and AFB staining.

UNIT II**MEDICAL MICROBIOLOGY****9**

Morphological features and Structural organization of Bacteria and Virus. Growth curve, culture media and its types, culture techniques. Routes of infection and spread; endogenous and exogenous infections, Disease caused by bacteria, fungi, protozoal, virus and helminthes. Medical Microbiology: Nosocomial infections:- Microbiology of hospital infections, common type of infections, diagnosis and control of infections, Factors responsible for Microbial pathogenesis.

UNIT III**IMMUNOPATHOLOGY****9**

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immune electrophoresis, RIA and ELISA, monoclonal antibodies.

UNIT IV**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, Benign and Malignant tumors, carcinogenesis, spread of tumors, Autopsy and biopsy.

UNIT V**FLUID AND HEMODYNAMIC DERANGEMENTS****9**

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



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Leukaemias, Lymphomas, Hemorrhage.

TOTAL: 45 HOURS

Course outcomes

At the end of the course students should be able to

- CO1** Explain the use of various microscopes and staining procedures in visualizing microbes
- CO2** Understand the structure, routes of infection and pathogenesis of various pathogens
- CO3** Assimilate the pathophysiology of immune disorders and understand the fundamentals of immunological techniques
- CO4** Describe the process of cell degeneration, repair and neoplasia
- CO5** Explain the various types of fluid and hemodynamic derangements
- CO6** Understand the structure, functions of microbes and concept of immunopathology

TEXT BOOKS

1. Pelczar TR M J Chan ECS and Kreig N R (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins,-athologic Basis of Diseases, 7thedition, WB Saunders Co. 2005 (Units I & II).
3. Ananthanarayanan&Panicker, Microbiology, Orientblackswan, 2017 10th edition. (Unit III, IV and V).

REFERENCES

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. A Text Book of Microbiology, Chand & Company Ltd, 2007
3. Prescott, Harley and Klein, Microbiology, 10th edition, McGraw Hill, 2017.



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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1										3	1
CO2	2	2	3										3	2
CO3	2	3	3										1	2
CO4	2	3	3										3	2
CO5	1	3	2										3	2
CO6	2	3	3										3	2

LAB COMPONENT CONTENTS

1. Telephone conversation
2. One Minute Talk (Prepared)
3. Describing a holiday / festivals / special events
4. BBC Hard Talk / NDTV Big Fight
5. Impromptu Speech
6. Story writing
7. Story telling
8. Open ended stories
9. Peacha Kucha
10. Book Review
11. Blog writing
12. TED Talk Presentation

Total: 15 HOURS

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Course outcomes

At the end of the course students should be able to

- CO1** To understand the various of organs of speech
- CO2** To learn the pronunciation of vowels, Diphthongs, Consonants
- CO3** Familiarize the concepts of word transcription
- CO4** Identify the pronunciation patterns of language
- CO5** Understand where to use Intonation and word stress
- CO6** Develop the skills on conversation, self introduction etc



ASL

Objectives

The students should be made

- To write modular programs consisting of structure, functions and pointer concepts.
- To define the files, file manipulations
- To use structure variables for data storage and manipulation.
- To get the Knowledge about linear data structure.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3							2	2	3
CO2	3	2	2	1	3							2	2	3
CO3	3	2	2	1	3							2	2	3
CO4	3	2	1	1	3							2	2	3
CO5	3	2	2	1	3							2	2	3
CO6	3	2	2	1	3							2	2	3

List of Programs

1. Programs on pointer operators, call by reference, pointers with arrays
2. Programs using structures and unions.
3. Implementation of linked list
4. Applications of linked list
5. Implementation of stack
6. Applications of stack
7. Implementation of Queue
8. Applications of queue
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.

TOTAL: 15 HOURS**Outcomes**

At the end of the course students should be able to

- CO1 Inscribe C programs that use Pointers to access arrays, strings and functions.
- CO2 Exercise user defined data types including structures and unions to solve problems
- CO3 Exercise files concept to show input and output of files in
- CO4 Inscribe C programs using pointers and to allocate memory using dynamic memory management functions.
- CO5 Understand the concepts of Linear data structures.
- CO6 Apply good programming design methods for program development.

Objectives

The students should be made

- Estimate and quantify biomolecules.
- Separate macromolecules.
- Estimate and interpret biochemical parameter.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3				1					1	1	2
CO2	3	3	1				2					1	1	1
CO3	3	3	3				2					1	1	1
CO4	3	3	2				2					2	1	1
CO5	3	3	3				2					1	1	1
CO6	3	1	3				2					1	1	1

List of Programs

1. Preparation of normal, molar, percentage and buffer solutions.
2. Qualitative analysis of carbohydrates, proteins and lipids
3. Separation of serum and plasma from blood.
4. Estimation of blood glucose.
5. Estimation of proteins.
6. Estimation of Cholesterol.
7. Estimation of Creatinine.
8. Estimation of Uric Acid.
9. Separation of protein by SDS-PAGE (Demo)
10. Separation of Amino Acid by TLC (Demo)

TOTAL: 15 HOURS**Outcomes**

At the end of the course students should be able to

- CO1 Understand the basics principle of preparation of buffers and to perform qualitative test of different biomolecules.
- CO2 To perform quantitative analysis of various biomolecules in blood sample.
- CO3 Have a sound knowledge of separation technology of proteins and aminoacids..
- CO4 Understand the basics knowledge of Biochemical parameter and their interpretation in Blood sample.
- CO5 Have a sound knowledge of separation technology of proteins and aminoacids.
- CO6 Practice on operation of macromolecules and quantification of biomolecules

Objectives

The students should be made

- To use compound microscope and understand its parts
- To perform various staining techniques
- To collect and store blood and urine samples

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2										2	
CO2	3	2	3										1	
CO3	2	1	3										2	
CO4	2	2	3										2	
CO5	3	2	3										2	
CO6	3	2	1										2	

List of Programs

1. Study of parts of Microscope
2. Manual paraffin tissue processing and section cutting (demonstration)
3. Cryo processing of tissue and cryosectioning (demonstration)
4. Capsule stain
5. Simple stain.
6. Gram stain.
7. AFB stain.
8. Antigen-Antibody Reaction Immuno electrophoresis
9. Sample collection : Urine and Blood sample collection and storage
10. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin, creatinine)

TOTAL: 15 HOURS**Course outcomes**

At the end of the course students should be able to

- CO1 Understand the basic steps in tissue processing
- CO2 Perform various staining procedures and analyse the need for various staining techniques
- CO3 Collect, store and analyse biological fluids
- CO4 Practice on various staining procedures
- CO5 Recognize different types of tissues and its functions
- CO6 Analyse the structure of blood cells for various diseased conditions

Course Objectives

The students should be made

- To learn about the project management and the importance of team work.
- To analyse engineering solutions from ethical and sustainability perspectives.
- To apply basics of engineering project management skills in product development
- To build a simple systems/prototypes using engineering development process.
- To test the working and improvements required if any.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1	1									2	3	1
CO2	3	3	3	2									3	3
CO3			3	3	3							2	3	2
CO4						3	3	3					3	3
CO5									3	3	3	2	3	3
CO6									3	3	3	2		

Course Project reviews & Project Work Hours (PWH)

15

CONTENTS		
S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform-based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	6
6	Ethics	
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

TOTAL: 30 HOURS

Outcomes

At the end of the course students should be able to

- CO1 Understand the role of an engineer as a problem solver
- CO2 Apply multi-disciplinary principles and build systems using engineering design process
- CO3 Use appropriate tools for designing and development of solutions.
- CO4 Analyze engineering solutions from ethical and sustainability perspectives
- CO5 Use basics of engineering project management skills while doing projects
- CO6 Communicate, Collaborate and work as a team



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GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.



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GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.

TOTAL: 30 HOURS

Outcomes

At the end of the course, learners will be able to:

- CO1 Formulate a real world problem, identify the requirement and develop the design solutions.
- CO2 Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- CO3 Work as team and know their responsibilities in the team
- CO4 Effectively plan and manage the project timeline and budget
- CO5 Communicate with engineers and the community at large in written and oral forms
- CO6 Develop the skills to formulate a technical project.



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 Understand the fundamental knowledge of probability
- CO2 Understand the basic concepts of two dimensional random variables and apply in engineering applications
- CO3 To know Random variable standard distributions which can describe real life phenomenon
- CO4 To solve problems related to random processes, correlation and spectral densities
- CO5 To work on problems related to linear systems with random inputs
- CO6 To understand the ideas of testing of hypothesis

TEXT BOOKS

1. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, New Delhi, 2002.
2. Bernard Rosner, Fundamental of Biostatistics, Duxbury Thomson Learning, New York,2006.

REFERENCES

1. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
2. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
3. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, Asia, 2002
4. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012
5. Richard I Levin and David. S. Rubin, Statistics for Management, Pearson Education, New Delhi,2009



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Course Objectives

The students should be made

- To learn the working principles of Discrete Fourier transform.
- To know the characteristics of IIR and FIR filters.
- To learn the design of infinite and finite impulse response filters for filtering undesired signals.
- To understand the Finite word length effects.
- To study the basic applications of signal processing in biomedical field.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1								3	2
CO2	3	2	2	2	1								3	2
CO3	3	2	1	2	1								3	2
CO4	3	2	2	1	1								3	2
CO5	3	2	2	1	1								3	2
CO6	3	2	2	1	1								3	2

UNIT I**DISCRETE FOURIER TRANSFORM****12**

Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution – Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

UNIT II**IIR FILTER DESIGN****12**

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

UNIT III**FIR FILTER DESIGN****12**

Structures of FIR – Linear phase FIR filter – Fourier Series – Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques

UNIT IV**FINITE WORD LENGTH EFFECTS****12**

Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors – Quantization noise – coefficient quantization error – Product quantization error – Overflow error – Noise Power Spectrum - Round off noise power – limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

UNIT V**DSP APPLICATIONS IN BIOMEDICAL FIELD****12**

Multirate signal processing for Biomedical signal analysis: Decimation, Interpolation, Sampling rate conversion by a rational factor for medical data analysis, decomposition of biomedical signal – Adaptive Filters for Noise removal in ECG, EEG signals: FIR and IIR filter design for biosignal smoothing, filtering. Extraction of ECG and neuro signal features



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 To learn the working principles of Discrete Fourier transform.
- CO2 To know the characteristics of IIR and FIR filters.
- CO3 To learn the design of infinite and finite impulse response filters for filtering undesired signals.
- CO4 To understand the Finite word length effects.
- CO5 Understand the concepts of convolution and correlation process in filter design
- CO6 To study the basic applications of signal processing in biomedical field

TEXT BOOKS

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.

REFERENCES

1. Emmanuel C. Ifeachor, &Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3. A.V. Oppenheim, R.W. Schaffer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006



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Course Objectives

The students should be made

- To introduce the methods of mesh current and node voltage analysis and their application.
- To illustrate graph theory and its application in estimating electrical parameters in the circuit.
- To describe network theorems and its applications.
- To highlight the application of Laplace and Inverse Laplace transform in analyzing circuits.
- To familiarize with resonance in circuits and methods for evaluating the same.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1							2	2	
CO2	2	3	3	2	2							2	2	
CO3	3	1	3	1	2							1	2	
CO4	3	3	3	2	2							2	2	
CO5	3	3	3	2	2							2	2	
CO6	3	3	2	2	1							2	2	

UNIT I BASICS OF CIRCUIT ANALYSIS 9

Basic components of electrical circuits, voltage and current laws, Mesh and nodal analysis for D.C and A.C. circuits. Network reduction: voltage and current division, source transformation – star- delta conversion.

UNIT II NETWORK TOPOLOGIES 9

Concept of Duality, Dual network, Graphs of a network, Trees, twig, link and branches, Incidence matrix, Tie-set matrix formation and cut-set matrix formation of a graph.

UNIT III NETWORK THEOREMS AND APPLICATIONS 9

Linearity- Thevenin's theorem - Norton's theorem- Super position theorem- Maximum power transfer theorem- Reciprocity theorem - Compensation theorem- Tellegen's theorem- Millman's theorem, applications of theorems

UNIT IV TRANSIENT ANALYSIS 9

Differential equations / Laplace Transform - Steady state and transient response: DC response of RL, RC and RLC circuit - Sinusoidal response of RL, RC and RLC circuits.

UNIT V APPLICATIONS OF CIRCUITS IN BIOMEDICAL FIELD 9

Circuits for ECG electrodes – Measurement of skin contact impedance – Biopotential Amplifiers – Instrumentation amplifiers, carrier amplifiers, chopper amplifier – Isolation preamplifier for ECG – Biotelemetry – frequency modulator circuits, pulse width modulator circuits.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:



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- CO1 Analyze circuits using Node voltage and Mesh Current Analysis in electrical networks and solve related problems
- CO2 Describe and Design Graph and Trees for a given network and build network matrices and solve related problems
- CO3 Evaluate network parameters by applying Network theorems.
- CO4 Apply Laplace transform and form transfer function for different kinds of electrical networks and solve related problems
- CO5 Assess the applications of circuits in Biomedical Field.
- CO6 Develop the capacity to analyze electrical circuits, apply the circuit theorems in real time

TEXT BOOKS

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016
2. Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.
3. Khandpur R.S, —Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw-Hill, New Delhi, 2014.

REFERENCES

1. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, Fifth Edition, McGraw Hill, 9th Reprint 2015.
2. A. Bruce Carlson, Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, Cengage Learning, India Edition 2nd Indian Reprint 2009
3. Allan H. Robbins, Wilhelm C. Miller, Circuit Analysis Theory and Practice, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.



Course Objectives

The students should be made

- To impart knowledge of the principle of operation and design of sensory equipments.
- To render a broad and modern account of neurological, muscular, cardiological and respiratory instruments.
- To introduce idea about instrumentation in patient care and diagnosis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3									3	2
CO2	3	3	3	3									3	2
CO3	3	2	2	3									3	2
CO4	3	3	3	3									3	2
CO5	3	3	3	3									3	2
CO6	3	2	3	2									3	2

UNIT I**SENSORY INSTRUMENTATION****9**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Hearing and speech aids: conductive and nervous, hearing aids- Types, constructional and functional characteristics. Cochlear implants- Need, constructional details, speech trainer.

UNIT II**NEUROLOGICAL EQUIPMENTS****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 OPHTHALMIC SIGNALS****9**

Recording and analysis of EMG Signals, fatigue characteristics; Recording and analysis of EOG, ERG-significance and its application

UNIT IV**CARDIOLOGICAL EQUIPMENTS****9**

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT V**RESPIRATORY EQUIPMENTS****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.



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 Demonstrate the principle of operation and design of sensory equipments
- CO2 Understand the significance of brain signal acquisition and evoked potential
- CO3 Record and analyze EMG, EOG and ERG signals.
- CO4 Illustrate the principle and working of cardiological equipments
- CO5 Analyse the working of diagnostic and therapeutic respiratory equipments
- CO6 To interpret biomedical instruments used for patient care and diagnosis

TEXT BOOKS

1. John G. Webster, —Medical Instrumentation Application and Designl, 4th edition, Wiley India Pvt. Ltd, New Delhi, 2015
2. Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technologyl, Pearson education, 2012.
3. Leslie Cromwell, —Biomedical Instrumentation and measurementl, 2nd edition, Prentice hall of India, New Delhi, 2015.
4. Richard Aston —Principles of Biomedical Instrumentation and Measurementl, Merril Publishing Company, 1990.

REFERENCES

1. L.A Geddas and L.E. Baker —Principles of Applied Biomedical Instrumentationl 2004
2. Myer Kutz —Standard Handbook of Biomedical Engineering & Designl, McGraw-Hill Publisher, 2003
3. Khandpur R.S, —Handbook of Biomedical Instrumentationl, 3rd edition, Tata McGraw-Hill, New Delhi, 2014



Course Objectives

The students should be made to

- Understand the production of x-rays and its application in imaging.
- Describe the principle and process of computed tomography.
- Know the fundamentals of Magnetic Resonance Imaging.
- Learn different types of nuclear imaging techniques.
- Learn the various radiation therapy methodologies and radiation safety measures

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2										3	2
CO2	2	3	3										3	2
CO3	2	3	3										3	2
CO4	2	3	3										3	2
CO5	2	3	2										3	2
CO6	2	3	1										3	2

UNIT I X-RAY TECHNIQUES 9

Nature of X-Rays – Production of X-Rays – Block diagram of X-Ray machine – X-Ray tube – Collimators and grids – Power supply – Digital Radiography – X-Ray image intensifier – Fluoroscopy – Angiography – Mammography – Dental X-Ray machine

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. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application.

UNIT III MAGNETIC RESONANCE IMAGING 9

MR Active Nucleus – Alignment – Precession – Resonance – Relaxation – Pulse timing parameters – Contrast agents – Instrumentation of MRI – Magnets – Shim coils – Gradient coils – RF coils – MRI safety – fMRI

UNIT IV NUCLEAR MEDICINE 9

Radio-isotopes – Alpha, beta and gamma emissions – Gamma Camera – Principle of SPECT – Principle of PET – Recent advances in Radionuclide imaging – Bone imaging, dynamic renal function, myocardial perfusion – Non imaging techniques – hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting

UNITV RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT, Recent Techniques in radiation therapy – 3DCRT – IMRT – IGRT and Cyber knife – radiation measuring instruments



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Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter- Radiation protection in medicine- radiation protection principles.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Describe the working principle of X-ray machine and its application.
- CO2 Illustrate the principle and working of computed tomography in medical diagnosis
- CO3 Interpret the techniques used for visualizing various sections of the body using Magnetic Resonance Imaging (MRI) technique
- CO4 Demonstrate the applications of radionuclide imaging
- CO5 Illustrate the applications of radiation therapy and assimilate various measures of radiation safety.
- CO6 Application of radiation in diagnostic and therapeutic process

TEXT BOOKS

1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelphia, 1988
2. R. Hendee and Russell Ritenour, Medical Imaging Physics, Fourth Edition, William, Wiley Liss, 2002
3. RS Khandpur, Handbook of Biomedical Instrumentation, 2nd edition, Tata McGraw-Hill Publishing Company Limited, 2003.

REFERENCES

1. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, Third edition, Springer, 2006
2. BH Brown, PV Lawford, RH Small wood, DR Hlose, DC Barber, Medical physics and Biomedical Engineering, CRC Press, 1999.
3. Myer Kutz, Standard handbook of Biomedical Engineering and design, McGraw Hill, 2003.
4. Catherine Westbrook, Carolyn Kaut Roth, John Talbot, MRI in Practice, 4th edition, John Wiley & Sons Ltd, 2011



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Course Objectives

The students should be made

- To learn about the ecology and ecosystem.
- To learn about the biodiversity and its conservation.
- To learn about the Environmental pollution and human health.
- To learn about the issues faced by environment and the ethics to protect the environment.
- To learn about the role of biomedical engineers in protecting the environment.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3				3	3	3	1	2	1	3	1
CO2	3	1	2				3	3	3	1	2	1	3	1
CO3	3	1	3				3	3	3	1	2	1	3	1
CO4	3	1	2				3	3	3	1	2	1	3	1
CO5	3	1	3				3	3	3	1	2	1	3	1
CO6	3	1	2				3	3	3	1	2	1	3	1

UNIT I**ECOLOGY AND ECOSYSTEM****9**

Ecosystem – Concept and Function - Abiotic and Biotic components, Ecological pyramids, The Energy flow in Biosphere and in Ecosystems. Energy Flow, biogeochemical cycles of nitrogen, carbon, phosphorus, sulphur. Abiotic and Biotic factors and interactions - Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific. Ecosystem - Structure and function of Terrestrial, Aquatic, Forest and Desert ecosystems. Ecotypes, Ecospecies, Community – analytical and synthetic characters; Ecotone, Edge effect.

UNIT II**BIODIVERSITY AND CONSERVATION****9**

Definition, Types of diversity and significance, criteria and measurement of biodiversity, factors affecting biodiversity, IUCN Criteria of endangerment, Red Data Books. Endemics and Epibiotics. Mega biodiversity nations, Hotspots of biodiversity, Biodiversity conservation strategies: in-situ conservation, ex-situ conservation, Biodiversity Conservation Efforts: Wildlife of India, Preservation of Breeding Stock; Artificial stocking and Habitat Improvement, Game Farming. Valuation of Biodiversity, Bioprospecting. Biopiracy

UNIT III**ENVIRONMENTAL POLLUTION AND HUMAN HEALTH****9**

Air Pollution, Classification of Pollutants . Effects of air pollution in plants, animals, human beings and ecosystem. Water Pollution: Types of water pollution, Effects of water pollution in aquatic ecosystems, animals, Agriculture and Human life. Thermal, Radiation Pollution: Sources, Effects of pollution on human and animals. Soil Pollution: Sources and Types of Soil pollution , Effects of soil pollutants on flora, fauna and ground water. Noise Pollution: Types of noise pollution, Effects of noise pollution on human and animals.

UNIT IV**ENVIRONMENTAL ISSUES AND ETHICS: REGIONAL AND GLOBAL****9**

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Objective

The students should be made

- To Develop students' ability to participate in the conversation.
- Develop an ability to use a number of key functional exponents with confidence and accuracy.
- To enable students to learn to interpret given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- To improve students' analytical and data interpretation skills.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	3				2	1		3	3		3	1
CO2		3	3				2	1		3	2		3	2
CO3		3	2				2	1		3	3		1	2
CO4		3	2				3	1		3	3		3	2
CO5									2	2		2	3	2
CO6		3	3				2	1		3	3		3	2

UNIT I VEDIC MATHEMATICS AND SUDOKU 3

Applied Language Skills: Self Introduction - Attending Interviews - Greeting - Starting a conversation- Social Conversation Skills

Quants: ANALOGY PATTERN RECOGNITION - Relating two objects - Problems on Number Analogy - Pattern completion.

UNIT II NUMBER SYSTEM – LCM & HCF – SIMPLIFICATION – SURDS & INDICES – CYCLICITY- EQUATIONS 3

Applied Language Skills: Asking and Giving Information - Apologizing and Excusing - Giving Instructions - Roleplays

Quants: CODING AND DECODING PATTERN RECOGNITION - Coding and decoding by letter shifting- Coding Letters of a Word-Coding and decoding in fictitious language

UNIT III FUNDAMENTALS OF ALGEBRA - AVERAGES 3

Applied Language Skills: Agreeing and disagreeing - Inviting, accepting and declining invitations - Negotiating Skills - Persuasive Skills - Debate

Quants: ANALYTICAL REASONING - Problems related to shapes – To find the missing numbers - Shape Construction - Cubes & Dices.

UNIT IV PERCENTAGES – RATIOS AND PROPORTION 3

Applied Language Skills: Expressing likes and dislikes - Complimenting - Mock Interviews - GD

Quants: Cognitive Problems & Puzzles - Find the next Image- Mirror Image- Water Image - Logical Puzzle

UNIT V PARTNERSHIP - MIXTURES AND ALLEGATIONS - PROBLEM ON AGES 3

Applied Language Skills: Taking up certificate speaking test



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Quants: VEDIC MATHEMATICS AND SUDOKU - Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots – Square roots - Logic- based Sudoku

TOTAL: 15 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Able to participate in formal/informal conversations
- CO2 Speak in different contexts confidently and accurately
- CO3 Ability to interpret the given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- CO4 To improve analytical and data interpretation skills.
- CO5 Apply the skills in speaking and writing.
- CO6 Apply the language skills in SUDOKU

TEXT BOOKS

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny, and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand & Co Ltd., New Delhi. Analytical Reasoning by M.K Pandey

REFERENCES

1. Interact English Lab Manual for Undergraduate Students. Orient BlackSwan: Hyderabad, 2016
2. Raman, Meenakshi, and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT", McGraw Hill Education; Eighth edition 2018.
4. Arun Sharma "How to Prepare for Logical Reasoning for the CAT", McGraw Hill Education; Eighth edition, 2018.

WEB RESOURCES

1. <https://www.ted.com/talks>
2. <https://www.toastmasters.org/>
3. <https://www.edudose.com/reasoning/>
4. <https://testbook.com/aptitude-practice/>



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Objectives

The students should be made

- To have hands-on IoT concepts such as sensing, actuation and communication.
- To develop Internet of Things (IoT) prototypes—including devices for sensing, actuation, processing, and communication

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2		1								2	
CO2	3	2	2										2	
CO3	3	2	2		1								2	
CO4	3	2	2		1								2	
CO5	2	2	2		1								2	
CO6	3	2	2		1								2	

UNIT I**Introduction****6**

Microprocessor & Microcontroller Classification, Registers & Memory of AT89C51, Introduction of EMBEDDED C , Difference between C & Embedded C Programming style

UNIT II**Arduino Simulation Environment****6**

Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD

UNIT III**Sensor & Actuators with Arduino****6**

Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino

UNIT IV**Basic Networking with ESP8266 WiFi module****6**

Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server- introduction, installation, configuration, Posting sensor(s) data to web server

UNIT V**Cloud Platforms****6**

Communication Protocols, Virtualization concepts and Cloud Architecture, Study of Cloud platforms, ThingSpeak API and MQTT, Interfacing ESP8266 with Web services

TOTAL: 30 HOURS**Course Outcomes**

At the end of the course, learners will be able to:

- CO1 To understand the basic concepts of Embedded C
- CO2 To develop skills to work with arduino uno and its interfacing with various components
- CO3 Able to analyse the working of sensors and actuators with arduino
- CO4 Familiarize the concept of networking with ESP8266 Wifi module
- CO5 To undertsand the cloud platforms and its interfacing features
- CO6 Understand configuration and installation of ESP8266 Wi-Fi Module

TEXT BOOKS

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

REFERENCES

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.



ASL

Objectives

The students should be made

- To develop skills to formulate a technical project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronic/ Instrumentation system.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
- To provide guidelines to prepare technical report of the project.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	2	2							3	1
CO2	3	3	3	3	2	2							3	3
CO3	1	3	3	3	2	1							3	2
CO4	3	3	3	1	2	2							3	3
CO5	3	3	3	3	2	2							3	3
CO6	3	2	2	3	2	2							3	3

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	6
6	Ethics	
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

GUIDELINES

- Practical based learning carrying credits.
- Multi-disciplinary/ Multi-focus group of 3-4 students.
- Groups can select to work on specific tasks, or projects related to real world problems.
- Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
- The students have to display their model at the end of semester.

TOTAL: 30 HOURS

Outcomes

At the end of the course, learners will be able to:

- CO1 Formulate a real world problem, identify the requirement and develop the design solutions.
- CO2 Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- CO3 Work as team and know their responsibilities in the team
- CO4 Effectively plan and manage the project timeline and budget
- CO5 Communicate with engineers and the community at large in written and oral forms
- CO6 Develop the skills to formulate a technical project.



Objective

The students should be made

- To learn the working principles of Discrete Fourier transform.
- To know the characteristics of IIR and FIR filters.
- To learn the design of infinite and finite impulse response filters for filtering undesired signals.
- To understand the Finite word length effects.
- To study the basic applications of signal processing in biomedical field.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1								3	2
CO2	3	2	2	2	1								3	2
CO3	3	2	1	2	1								3	2
CO4	3	2	2	1	1								3	2
CO5	3	2	2	1	1								3	2
CO6	3	2	2	1	1								3	2

List of Experiments

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
7. Design multirate filters

TOTAL: 15 HOURS**Outcomes**

At the end of the course, learners will be able to:

- CO1 To understand the working principles of Discrete Fourier transform.
- CO2 To know the characteristics of IIR and FIR filters.
- CO3 To design infinite and finite impulse response filters for filtering undesired signals.
- CO4 To understand the Finite word length effects.
- CO5 To apply the basic principles of signal processing in biomedical field.
- CO6 To design multirate filters

Objective

The students should be made

- To introduce the methods of mesh current and node voltage analysis and their application.
- To illustrate graph theory and its application in estimating electrical parameters in the circuit.
- To describe network theorems and its applications.
- To highlight the application of Laplace and Inverse Laplace transform in analyzing circuits.
- To familiarize with resonance in circuits and methods for evaluating the same

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1							2	2	
CO2	3	3	2	1	1							2	2	
CO3	3	3	3	1	1							2	2	
CO4	3	3	3	1	1							2	2	
CO5	3	3	3	1	1							2	2	
CO6	3	3	3	2	2							2	2	

List of Experiments

1. Verifications of Thevenin theorem
2. Verifications of Norton theorem
3. Verifications of KVL & KCL
4. Verifications of Super Position Theorem
5. Verifications of maximum power transfer & reciprocity theorem
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Design of parallel resonance circuit
8. Experimental validation of frequency response of RLC electric circuit
9. Design of series resonance circuit
10. Transient analysis of RL and RC circuits

TOTAL: 15 HOURS**Course Outcomes**

At the end of the course, learners will be able to:

- CO1 To introduce the methods of mesh current and node voltage analysis and their application.
- CO2 To illustrate graph theory and its application in estimating electrical parameters in the circuit.
- CO3 To describe network theorems and its applications.
- CO4 To understand oscilloscope and its measurement process
- CO5 To familiarize with resonance in circuits and methods for evaluating the same
- CO6 To apply various theorems for understanding electrical parameters of circuits

Objective

The students should be made

- To impart knowledge of the principle of operation and design of sensory equipments.
- To render a broad and modern account of neurological, muscular, cardiological and respiratory instruments.
- To introduce idea about instrumentation in patient care and diagnosis

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO222.1	3	2	2	3									3	2
CO222.2	3	3	3	3									3	2
CO222.3	3	2	2	3									3	2
CO222.4	3	3	3	3									3	2
CO222.5	3	3	3	3									3	2
CO222.6	3	2	3	2									3	2

List of Experiments

- Design and analysis of biological pre amplifiers
- Design and recording of ECG signal and analysis
- Design and recording of EMG-Signal
- Design and recording of EEG-Signal
- Pulmonary function measurement and analysis using spirometer
- Measurement of oxygen saturation level using pulse oximeter
- Recording of various physiological parameters using patient monitoring system
- Measurement of pH and conductivity
- Measurement and recording of peripheral blood flow
- Measurement of visually evoked potential
- Understanding the concept of biotelemetry: ECG, EEG, pulse

TOTAL: 15 HOURS**Outcomes**

At the end of the course, learners will be able to:

- CO1 To impart knowledge of the principle of operation and design of sensory equipments.
- CO2 To acquire and display various biosignals and clinical parameters
- CO3 To demonstrate the working of instrumentation in patient care and diagnosis
- CO4 Illustrate the principle and working of visually evoked potential
- CO5 To understand the concept of biotelemetry process.
- CO6 To perform pulmonary function measurement and analysis using respiratory care equipments

SEMESTER V

U19BMTLS10T

BIOMEDICAL IMAGE PROCESSING

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3	0	0	3

Course Objectives

The students should be made

- To understand the basics of digital images
- To study about the various image enhancement techniques
- To learn about the noise models and the image restoration
- To know the importance of image segmentation and compression
- To be familiar with the image recognition

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	2	2							3	1
CO2	3	3	3	3	2	2							3	3
CO3	1	3	3	3	2	1							3	2
CO4	3	3	3	1	2	2							3	3
CO5	3	3	3	3	2	2							3	3
CO6	3	2	2	3	2	2							3	3

UNIT I

DIGITAL IMAGE FUNDAMENTALS

9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II

IMAGE ENHANCEMENT

9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering – Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III

IMAGE RESTORATION

9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV

IMAGE SEGMENTATION

9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing – erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm

UNIT V

IMAGE COMPRESSION AND RECOGNITION

9



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Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors - Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms
- CO2 Operate on images using the techniques of smoothing, sharpening and enhancement
- CO3 Understand the basics of segmentation, features extraction, compression and recognition methods for color models.
- CO4 Learn the wavelet analysis and image compression techniques
- CO5 Illustrate about image representation and its recognition process
- CO6 Exposed to simple image processing techniques and its features

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2010.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2011.
3. William K. Pratt, Digital Image Processing, John Wiley, New York, 2002
4. DE Dudgeon and RM Mersereau, Multidimensional Digital Signal Processing, Prentice Hall Professional Technical Reference, 1990.
5. Milan Sonka et al, Image processing, analysis and machine vision, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.



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Course Objectives

The students should be made

- To understand the concept behind feedback and continuum in various systems and subsystems.
- To analyze the systems in time and frequency domain and to understand the concept of stability
- To apply mathematical modeling principles in understanding the various fundamental biological systems
- To analyze biological system models using MATLAB

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2									3	2
CO2	3	3	2	2									3	2
CO3	3	3	2	2									3	2
CO4	3	3	2	2									3	2
CO5	2	2	2	2									3	2
CO6	3	3	2	2									3	2

UNIT I**INTRODUCTION****9**

Open and Closed loop Systems, Modeling and Block Diagrams, 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 system.

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

UNIT III**FREQUENCY RESPONSE ANALYSIS****9**

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

UNIT IV**BIOLOGICAL SYSTEM MODELS****9**

Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco-elasticity-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems - Regulation of cardiac output, Regulation of ventilation.

UNIT V**BIOLOGICAL CONTROL SYSTEM ANALYSIS****9**

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

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Understand 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 Analyze the time response of various systems and discuss the concept of system stability
- CO3 Analyze the frequency response characteristics of various systems using different charts
- CO4 Understand the concept of modeling basic physiological systems
- CO5 Comprehend the application aspects of time and frequency response analysis in physiological control systems
- CO6 Apply concepts of control systems in biological process and perform its analysis

TEXT BOOKS

1. J. Nagarath and M. Gopal —Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008.
2. Michael C K Khoo, —Physiological Control SystemsI, IEEE Press, Prentice Hall of India, 2005.

REFERENCES

1. Benjamin C. Kuo, —Automatic Control Systems, Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino —Introduction to Biomedical EngineeringI, second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, —Modern control systemsI, Pearson, 2004.



ASL

Course Objectives

The students should be able

- To study Digital Electronics principles and design.
- To study the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To study about communication and bus interfacing.
- To study the Architecture of 8051 microcontroller.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2								1	2
CO2	3	3	3	3	2								3	3
CO3	1	3	3	3	2								3	3
CO4	3	3	3	3	2								3	3
CO5	3	2	3	3	2								3	3
CO6	3	3	3	3	1								3	1

UNIT I PRINCIPLES OF DIGITAL ELECTRONICS 9

Number systems, Boolean algebra; combinational logic circuits - arithmetic circuits, comparators, Schmitt trigger, encoder/decoder, MUX/DEMUX, multi-vibrators; Sequential circuits - latches and flip flops, state diagrams, shift registers and counters; Principles of ADC and DAC.

UNIT II THE 8086 MICROPROCESSORS 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 III 8086 SYSTEM BUS STRUCTURE 9

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

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 I/O INTERFACING USING 8086/8051 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.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Understand and 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 Understand the interfacing of microcontroller
- CO6 Analyse the architecture and design aspects of microprocessor and microcontroller and its interface

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 GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
3. Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny Causey Printice Hall Of India, 2007.

REFERENCES

1. DouglasV.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH, 2012.



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Course Objectives

The students should be made

- To understand the need for regulations and standards for medical devices
- To gain knowledge about the international standards and organizations involved in medical device regulations
- To learn about the Indian standards and organizations that are framing regulations for medical devices in India
- To understand the difficulties in framing and implementing the regulations
- To know the accreditation bodies for hospitals and the importance of accreditation
- To analyze the effect of implementing standards on quality and safety in healthcare

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1								2	3
CO2	3	2	2	1	1								2	3
CO3	3	3	3	1	1								2	3
CO4	3	2	2	1	1								2	3
CO5	3	2	2	1	1								2	3
CO6	3	2	2	1	1								2	3

UNIT I**REGULATION OF MEDICAL DEVICES**

9

Introduction to regulatory requirements. Regulations, Standards, Codes and Specification-Definition and Difference. Types of standards for medical devices: Voluntary, Mandatory, Proprietary. Equipment classification based on method of protection and degree of protection- Data Exchange standards in Telemedicine-Safety Codes for Electro medical equipment.

UNIT II**INTERNATIONAL STANDARDS AND ORGANIZATIONS FOR
MEDICAL DEVICES**

9

International Organization for Standardization (ISO) ISO 9001, ISO 13485, ISO 14001, ISO 50001, ISO 45001, and ISO 27001- International Electrotechnical Commission (IEC) standards, FDA. Adoption of ISO by American National Standards Institute (ANSI), the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC)

UNIT III**INDIAN STANDARDS AND ORGANIZATIONS FOR MEDICAL
DEVICES**

9

Introduction to Central Drugs Standard Control Organization (CDSCO), Medical Equipment and Hospital Planning Division Council (MHDC) of BIS; Medical Devices Rules 2017: Salient features, Purpose and scope, License procedures, Classification of Medical Devices by MDR2017; CDSCO online medical devices portal

UNIT IV**INTERNATIONAL AND INDIAN ACCREDITATION BODIES FOR
HOSPITALS**

9

Accreditation Association for Ambulatory Health Care (AAAHC), Joint Commission International (JCI), National Accreditation Board for Hospitals & Healthcare Providers (NABH), Quality and Accreditation Institute (QAI), JCI, NABL



ARSL

Medical Device safety and risk management- participants in ensuring the safety of medical devices; Global Harmonization Task Force (GHTF)- Objective, scope and benefits, Global Medical Device Nomenclature (GMDN).

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 To understand the need for regulations and standards for medical devices
- CO2 To gain knowledge about the international standards and organizations involved in medical device regulations
- CO3 To learn about the Indian standards and organizations that are framing regulations for medical devices in India
- CO4 To understand the difficulties in framing and implementing the regulations
- CO5 To know the accreditation bodies for hospitals and the importance of accreditation
- CO6 To analyze the effect of implementing standards on quality and safety in healthcare

TEXT BOOKS

1. Seeram Ramakrishna, LinglingTian, Charlene Wang, "Medical Devices: Regulations, Standards and Practices", Woodhead Publishers 2015
2. World Health Organization, Medical device regulations: global overview and guiding principles. ISBN 9241546182.

REFERENCES

1. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rdedition, Tata McGraw-Hill, New Delhi, 2014.



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Course Objectives

The students should be made

- To know the basic building blocks of linear integrated circuits
- To study the applications of operational amplifiers
- To understand the theory and applications of analog multipliers and PLL.
- To learn the theory of ADC and DAC
- To assimilate the concepts of waveform generation and introduce some special function ICs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		1								2	
CO2	2		2		1								2	
CO3	3		2		1								2	
CO4	3		2		1								2	
CO5	3		2		1								2	
CO6	3		1		1								1	

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Basics of Differential amplifier – Differential gain, common Mode Gain, Common mode Rejection Ratio (CMRR), Features of Differential Amplifier, Transistorised differential amplifier – differential Mode operation, common mode operation, Differential amplifier circuit configuration – Op-amp symbol and terminals, power supply, General Op-amp stages, Input stage, Intermediate stage, Level shifting stage, output stage currents and impedances, Input stage of Op-amp IC 741, Intermediate stage of IC 741, level shift stage in Op-amp, output stage in Op-amp. Opamp IC 741 – Internal schematic of IC 741, PIN diagram, ideal Vs practical characteristics of IC 741 Op-amp, Features of Op amp.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters - basics

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier circuit, multiplier Integrated circuit, performance parameters of multiplier IC, Applications of Multiplier, voltage divider using multiplier, squaring circuit using multiplier, Square rooting circuit using multiplier - Operation of the basic PLL, Voltage controlled oscillator, period of oscillation, closed loop analysis of PLL

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Sample and Hold circuit, analog switches, performance parameters of S/H circuits, DAC, performance of DAC, Types of D/A converter, Binary weighted resistor D/A converter, R/2R ladder D/A converter, ADC, performance parameters of ADC, Types of ADC – single ramp or single slope, dual slope, successive approximation, flash.



ASL

UNIT V**WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9**

Sine-wave oscillators, RC phase shift oscillator, Wien bridge oscillator using Op-amp Multivibrators and its types- monostable, astable, bistable multivibrators. ICL8038 function generator, circuit diagram, frequency of output waveform, pin configuration of ICL 8038
Timer IC 555, pin and functional block diagram of IC 555, IC Voltage regulators –characteristics of voltage regulators- IC 723 general purpose regulator, Isolation Amplifier, Opto-couplers and fibre optic IC.

TOTAL: 45 HOURS**Course Outcomes**

At the end of the course, learners will be able to:

- CO1 To understand the basics of OP – AMPS
- CO2 To analyse the various application sof various OP-AMPS
- CO3 To Design applications using analog multiplier and PLL
- CO4 To learn the operations of ADC and DAC converters
- CO5 To familiarize the special function ICs and wave for generators
- CO6 Learn the analog operations, its conversions and waveforms

TEXT BOOKS

1. D. Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International. Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, Tata McGraw-Hill, 2016 (Unit I – V)

REFERENCES

1. William D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, 4th Edition, 2001
2. S. Salivahanan & V.S. KanchanaBhaskaran, Linear Integrated Circuits, TMH, 2nd Edition, 4th Reprint, 2016



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Objectives

The students should be made

- To develop making inferences and predictions based on comprehension of a text.
- To distinguish main idea(s) from supporting detail.
- To enhance problem-solving skills, to improve basic mathematical skills.
- To help the students who are preparing for any type of competitive examination.
- To draw conclusions and/or make decisions based on analysis and critique of quantitative information using proportional reasoning.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	3				2	1		3	3		3	1
CO2		3	3				2	1		3	2		3	2
CO3		3	2				2	1		3	3		1	2
CO4		3	2				3	1		3	3		3	2
CO5		3	2				2	1		3	3		3	2
CO6		3	2				3	1		3	3		3	2

UNIT I

3

Applied Language Skills : Reading for main ideas - Making Inferences- Identifying the theme - Writing different types of paragraphs - Parajumbles

Quants: NUMBER SYSTEM – LCM & HCF – SIMPLIFICATION – SURDS & INDICES – CYCLICITY- EQUATIONS - Classification on Numbers -Power cycles and remainders - Concept of highest common factor - concept of least common multiple - Divisibility Rule - Number of zeros in an expression - Problems on Surds and Indices - Concept of Unit digit - Simultaneous equations- Quadratic equations – In equation.

UNIT II

3

Applied Language Skills : Email etiquette - Email writing - Dangling modifiers - Writing different types of essays

Quants: FUNDAMENTALS OF ALGEBRA - AVERAGES - Variables - Algebraic expressions - Substitution & evaluating expressions - Writing algebraic expressions - PERCENTAGES – concept of percentage values through additions - fraction to percentage conversion table.

UNIT III

3

Applied Language Skills : Resume and cover letter writing - Visumes - Practice- Preparation of Resumes for placements

Quants: RATIOS AND PROPORTION- comparison of ratios - proportions - relation among the quantities more than two – variation. - PARTNERSHIP - MIXTURES AND ALLEGATIONS - PROBLEM ON AGES - Definition - Allegation rule - mean value (cost price) of the mixture - Problems on ages and Problems related to ratios

UNIT IV

3

Applied Language Skills : Technical Reports - Structure of the report - Critical Reasoning- Employee motivation, Satisfaction and commitment - Work Ethics



Quants: Problem on Ages - Profit & Loss - Discount - Simple Interest & Compound Interest - Data Interpretation.

UNIT V

3

Applied Language Skills : Organisational Communication - Leadership skills- Stress management - Self Appraisal - Taking up Reading test

Quants: Time, Speed & Distance - Problems on Trains - Boats & Streams - Data Sufficiency

TOTAL: 15 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Able to infer and predict content based on comprehension of a text
- CO2 Understand and distinguish main idea(s) from supporting detail
- CO3 Able to make decisions based on analysis and critique of quantitative information using proportional reasoning.
- CO4 Ability to enhance the problem-solving skills
- CO5 Evaluate the simple interest and compound interest
- CO6 Apply the language skills to build leadership skills.

TEXT BOOKS

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.
2. The Slight Edge, Jeff Olsen, Momentum Media, 2013
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand& Co Ltd., New Delhi
4. Arihant Publications," Quantitative Aptitude Quantum CAT ", Sarvesh Kumar Verma

REFERENCES

1. Interact English Lab Manual for Undergraduate Students. OrientBlackSwan: Hyderabad, 2016
2. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT " , McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018



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Objective

The students should be made

- To know the fundamentals of digital images
- To study about the various image enhancement techniques
- To learn about the noise models and the image restoration
- Know the importance of image segmentation and compression
- Familiar with the image recognition.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	3								2	2
CO2	2	3	3	2	3								2	3
CO3	2	3	3	2	3								2	3
CO4	1	3	3	2	3								2	3
CO5	2	3	3	1	3								2	1
CO6	2	2	3	2	3								2	3

List of Programs

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation
12. Segmentation using watershed transformation
13. Analysis of images with different color models.
14. Image compression techniques
15. Image restoration

TOTAL: 15 HOURS**Outcomes**

At the end of the course students should be able to

- CO1 Perform enhancing operations on the image using spatial filters and frequency domain filters
- CO2 Use transforms and analyse the characteristics of the image.
- CO3 Perform segmentation operations in the images.
- CO4 Estimate the efficiency of the compression technique on the images.
- CO5 Apply image processing technique to solve real health care problems.
- CO6 Explore the applications of image processing techniques.

Objective

The students should be made

- To Introduce ALP concepts, features and Coding methods
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2								1	2
CO2	3	3	3	3	2								3	3
CO3	1	3	3	3	2								3	3
CO4	3	3	3	3	2								3	3
CO5	3	2	3	3	2								3	3
CO6	3	3	3	3	1								3	1

List of Programs

8086 experiments

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
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

Peripheral Interfacing Experiments

7. Traffic light controller
8. Stepper motor control
9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

8051 experiments

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

TOTAL: 15 HOURS



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Outcomes

At the end of the course students should be able to

- CO1 Understand and 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 Understand the interfacing of microcontroller
- CO6 Analyse the architecture and design aspects of microprocessor and microcontroller and its interface



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Objective

The students should be made

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs .

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		2								2	
CO2	3		2		1								3	
CO3	3		1		1								2	
CO4	3		2		1								2	
CO5	2		1		1								2	
CO6	3		2		1								2	

List of Programs

1. Inverting, Non inverting and differential amplifiers
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass
5. Astable & Monostable multivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. R-2R Ladder Type D- A Converter using Op-amp.
11. DC power supply using LM317 and LM723.
12. Study of SMPS

TOTAL: 15 HOURS**Outcomes**

At the end of the course students should be able to

- CO1 Design oscillators and amplifiers using operational amplifiers.
- CO2 Design filters using Opamp and perform experiment on frequency response.
- CO3 Analyse the working of PLL and use PLL as frequency multiplier.
- CO4 Design DC power supply using ICs.
- CO5 Acquire knowledge in using SPICE
- CO6 Acquire knowledge in designing analog and digital circuits



Objectives

The students should be made

- To develop skills to formulate a technical project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronic/ Instrumentation system.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
- To provide guidelines to prepare technical report of the project.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2			3	2	3	2	3	3
CO2	3	3	3	3	2	2			3	2	3	2	3	3
CO3	3	3	3	3	2	2			3	2	3	2	3	3
CO4	3	3	3	3	2	2			3	2	3	2	3	3
CO5	3	3	3	3	2	2			3	2	3	2	3	3
CO6	3	3	3	3	2	2			3	2	3	2	3	3

S No	Topics	No of Hours
1	Introduction to Engineering	1
2	Platform based development	1
3	Mechanisms	2
4	Requirements	1
5	Design	3
6	Ethics	
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	3

GUIDELINES

- Practical based learning carrying credits.
- Multi-disciplinary/ Multi-focus group of 3-4 students.
- Groups can select to work on specific tasks, or projects related to real world problems.
- Each group has a faculty coordinator/instructor who will guide/evaluate the overall group as well as individual students.
- The students have to display their model at the end of semester.

TOTAL: 15 HOURS

Outcomes

At the end of the course, learners will be able to:

- CO1 Formulate a real world problem, identify the requirement and develop the design solutions.
- CO2 Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- CO3 Work as team and know their responsibilities in the team
- CO4 Effectively plan and manage the project timeline and budget
- CO5 Communicate with engineers and the community at large in written and oral forms
- CO6 To develop the skills to formulate a technical project



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Objectives

The students should be made

- To understand the hardware requirements of Internet of Things
- To understand the software requirements of Internet of Things
- To analyze the practical application of Internet of Things
- To learn the concepts for application of IOT for project
- To analyze various tools used in IOT

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2			3	2	3	2	3	3
CO2	3	3	3	3	2	2			3	2	3	2	3	3
CO3	3	3	3	3	2	2			3	2	3	2	3	3
CO4	3	3	3	3	2	2			3	2	3	2	3	3
CO5	3	3	3	3	2	2			3	2	3	2	3	3
CO6	3	3	3	3	2	2			3	2	3	2	3	3

UNIT I **HARDWARE REQUIREMENTS OF IOT** **3**

Routers, Switches, Sensors

UNIT II **SOFTWARE REQUIREMENTS OF IOT** **3**

Data collection, device integration, real-time analytics, AI (Artificial Intelligence), Sensors.

UNIT III **APPLICATION OF IOT** **3**

IOT in Home, IOT in Transport, Healthcare, Office, Education.

UNIT IV **IOT IN BIOMEDICAL ENGINEERING** **3**

Cloud based wearable ECG Monitoring for Smart Healthcare, Self-driving Cars, Artificial Intelligence, Wireless networks, Healthcare using IoT.

UNIT V **TOOLS IN IOT** **3**

Device Integration, Data collection, Data integration, RFID, LIFI, WIFI, Router Devices, NFC, Raspberry-pi, Qlink, Dell Boomi, Bluetooth, Zig-bee.

TOTAL: 15 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 To understand the hardware requirements of IOT
 CO2 Able to analyse the software requirements of IOT
 CO3 Analyse the real time application of IOT
 CO4 Understand the concept of IOT in biomedical engineering areas
 CO5 Comprehend the application of tools used in IOT
 CO6 Familiarize the concept of IOT applied in various domains



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TEXT BOOKS

2. 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

REFERENCES

6. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
7. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
8. 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.
9. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
10. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.



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SEMESTER VI

U19BMTL612T

MEDICAL ASSIST DEVICES

L	T	P	C
3	0	0	3

Objectives

The students should be made

- To introduce the basics of Assistive technology
- To introduce the application of assistive devices in mobility, hearing and vision
- To introduce the role of assistive methods in maintain the work of important organs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									3	2
CO2	3	1	1	1									3	2
CO3	3	1	2	1									3	2
CO4	3	2	2	1									3	2
CO5	3	2	2	1									3	2
CO6	3	3	2	2									3	2

UNIT I ASSISTIVE TECHNOLOGY IN ORTHOSIS & PROSTHESIS 9

Introduction to Assistive Technology – Universal design. Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis - Components of lower limb prosthesis, different types of models for externally powered limb prosthetics – Orthoses: types - Lower extremity- and upper extremity- orthoses - mobility aid, Slints – materials used.

UNIT II WHEEL CHAIR 9

Basic assessment and evaluation for mobility. Seating Assessment - Interventions in seating system - Biological aspects of tissue health - Support surface classification - Manual wheelchairs – Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation.

UNIT III ASSIST DEVICES-EYE 9

Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access- Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers, Orientation & navigation Aids – Ultra sonic and laser canes.

UNIT IV ASSIST DEVICES-EAR 9

Anatomy of ear – hearing functional assessment, Types of deafness - Surgical and non surgical hearing aids, Cochlear implants - Assistive technology solutions for hearing Tactile - Information Display, Voice synthesizer, speech trainer.

UNIT V ASSIST DEVICES FOR VITAL ORGANS 9



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TEXT BOOKS

2. 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

REFERENCES

6. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
7. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
8. Jan Ho" Iler, 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.
9. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
10. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.



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Cardiac assist devices, Intra-Aortic Balloon Pump (IABP), auxiliary ventricles. Dialysis for kidneys. Intermittent positive pressure breathing (IPPB) type assistance for lungs. Electrotherapy, Transcutaneous electrical nerve stimulator, Interferential current, Galvanic stimulation, Uses, safety aspects. Deep brain stimulation. Bio-feedback - Efficacy ratings - Major modalities – Applications

TOTAL: 45 HOURS

Outcomes

At the end of the course, learners will be able to:

- CO1 Study various mechanical techniques that will help failing heart.
- CO2 Learn the functioning of the unit which does the clearance of urea from the blood
- CO3 Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- CO4 Know the various orthodic devices and prosthetic devices to overcome orthopaedic problems.
- CO5 Understand electrical stimulation techniques used in clinical applications.
- CO6 Explain the functioning and usage of electromechanical units which will restore normal functional ability of particular organ that is defective temporarily or permanently

TEXT BOOK

1. Assistive Technology- Principles & Practice- Cook & Hussey
2. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visually impaired and blind people", Springer Publications, First edition, 2008.
3. Essentials of Assistive Technologies, By Albert M. Cook, Janice Miller Polgar.
4. Assistive Technology for Blindness and Low Vision edited by Roberto Manduchi, Sri Kurniawan.
5. Kenneth J. Turner, "Advances in Home Care Technologies: Results of the match Project", Springer, 1stedition, 2011.

REFERENCE BOOK

1. Gerr. M. Craddock "Assistive Technology-Shaping the future", IOS Press, 1st edition, 2003
2. Daniel Goldstein, Mehmet Oz, "Cardiac assist Devices", Wiley, 2000



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Course Objectives

The students should be made

- The objective of this to know the principle, design and application of various advanced biomedical equipments. Additionally, a brief introduction to design of future devices is included in every chapter.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2									3	1
CO2	2	1	1	2									3	1
CO3	3	1	2	2									2	2
CO4	3	1	2	2									3	1
CO5	3	1	2	2									3	1
CO6	3	2	1	2									3	1

UNIT I**STIMULATORS AND MAPPERS****9**

Sound stimulators- Measurement of average auditory stimulators-Visually evoked potential measurement and Analysis and storage - Brain mappers (EEG)- principles and Keratometers. evoked potential - application- Photo application - Recording- Amplifiers - measurements, Computerized tonometer.

UNIT II**ULTRASONOGRAPHY****9**

Transcutaneous Doppler Flow Detection, Flow meters, Ultrasonic Blood Pressure Measurement, Echoencephalography.

UNIT III**ADVANCED ANALYTICAL AIDS****9**

Advanced analytical aids - Fundamentals of NMR spectroscopy, X-ray spectrometers, mass spectrometers, Raman and Moss Beer spectroscopy. Blood Gas Analyzer, Automated Biochemical analysis Systems. Principles of scanning and transmission electron microscopy. Principles of simple, compound and phase contrast microscopes.

UNIT IV**COMPUTERS IN BIOMEDICAL EQUIPMENT****9**

Modern Microprocessors, Digital Signal Processors, Computer based patient record, Computing and health care, Computer system used in -X-ray, Nuclear, Computers in Biomedical Equipment.

UNIT V**ADVANCED DEVICES****9**

Cardiac pacemakers and modern stimulators, Hemodialyser, ventilators, incubators, drug delivery devices, surgical instruments, Therapeutic application of laser, Neonatal Monitoring.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 To explain the concept of simulators and brain mappers
- CO2 To interpret the concept of ultrasonography
- CO3 Study the principle of advanced analytical aids
- CO4 To understand the use of computers and processors in biomedical field
- CO5 To perform measurement process with advanced biomedical devices
- CO6 Familiarize with design of future devices in medical field

TEXT BOOK

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
2. John G. Webster, "Medical Instrumentation application and design", Wiley India Pvt Ltd, India, 4th edition, 2015.
3. Keith H. Chiappa, Evoked potential in clinical testing. Lippincott Williams & Wilkins.

REFERENCE BOOK

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007
2. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003
3. R.S.Khandpur, 'Handbook of Biomedical instrumentation', Tata McGraw Hill Publishing Co Ltd., 3rd edition, 2014.
4. J. D. Bronzino, The Biomedical Engineering Handbook- Vol. 1 & 2, Boca Raton, FL: CRC Press



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Course Objectives

The students should be made

- To develop strategies to improve students writing skills
- To learn to different types of documents used for business writing
- To Understand relevance & need of quantitative methods for making business decisions
- To demonstrate a sound knowledge of fundamentals of statistics and statistical techniques
- To apply quantitative methods to solve a variety of decision making problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		3	3				2	1		3	3	1	
CO2	2		3	3				2	1		3	2	1	
CO3	3		3	2				2	1		3	3	1	
CO4	4		3	2				3	1		3	3	2	
CO5	5		3	3				2	1		3	2	1	
CO6	6		3	2				2	1		3	3	1	

UNIT I

3

Applied Language Skills : Active Vocabulary - Writing Personal experiences - Process Description

Quants: Time & Work - Pipes & Cisterns - using fractions, percentages & negative work.

UNIT II

3

Applied Language Skills : Writing notices , business letters and reports(Minutes & Project)

Quants: Permutation & Combination - Probability - arrangements - selections - chances.

UNIT III

3

Applied Language Skills : Feasibility Report, Progressive report - Evaluation report

Quants: Geometry - Mensuration Concepts - Area & Volume - 2D & 3D.

UNIT IV

3

Applied Language Skills : Book review- Article writing - Writing mails - Letter to the editor

Quants: Trigonometry - Basic concepts - Heights & Distance and its applications.

UNIT V

3

Applied Language Skills : Taking up certificate test in reading

Quants: Sequence & Series - Progressions - AP, GP & HP - Data Interpretations - Data Sufficiency.

TOTAL: 15 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Able to participate in formal / informal conversations
- CO2 Speak in different contexts confidently and accurately
- CO3 Ability to understand relevance & need of quantitative methods for making business decisions
- CO4 Able to solve the real time problems statistically.
- CO5 Apply height and distance concepts in application skills.
- CO6 Study the AP, GP & HP data Interpretations.

TEXT BOOK

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny, and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Quantitative Aptitude for Competitive Examinations - R S Aggarwal
4. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal

REFERENCE BOOK

1. Interact English Lab Manual for Undergraduate Students. OrientBlackSwan: Hyderabad, 2016
2. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT " , McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018

WEB RESOURCES

1. <https://www.ted.com/talks>
2. <https://www.toastmasters.org/>
3. <https://testbook.com/aptitude-practice/>
4. <http://www.allindiaexams.in/online-test/online-aptitude-test/all>



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Objectives

The student should be made to

- Identify a scientific problem through extensive literature survey.
- Propose solution for the identified problem

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	2	2							3	1
CO2	3	3	3	3	2	2							3	3
CO3	1	3	3	3	2	1							3	2
CO4	3	3	3	1	2	2							3	3
CO5	3	3	3	3	2	2							3	3
CO6	3	2	2	3	2	2							3	3

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 HOURS

Outcomes

At the end of the course, learners will be able to:

- CO1** Formulate a real world problem, identify the requirement and develop the design solutions.
- CO2** Express the technical ideas, strategies and methodologies.
- CO3** Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- CO4** Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- CO5** Prepare report and present the oral demonstrations.
- CO6** Enable students to gain experience in organizing and implementing small projects

Objectives

The students should be made

- To learn the advanced principles of assist device modalities.
- Understand the device working mechanism and current technology used as assist devices

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									3	2
CO2	3	1	1	1									3	2
CO3	3	1	2	1									3	2
CO4	3	2	2	1									3	2
CO5	3	2	2	1									3	2
CO6	3	3	2	2									3	2

List of Programs

1. Operation and function of fluency assistance devices
2. Operation and function of pacemaker
3. Study of Prosthetic limbs.
4. Study of visual aids
5. Study of mobility aids
6. Study of hearing aids
7. Operation and function of cognitive aids
8. Study of assistive software and hardware
9. Study of TTS (Text to speech)
10. Study of screen readers

TOTAL: 15 HOURS**Course Outcomes**

At the end of the course students should be able to

- CO1** To get familiarize with the working of visual, mobility and hearing aids
- CO2** To learn about assistive software and hardware modules
- CO3** Understand the working mechanism of assistive devices technology
- CO4** To learn the advanced principles of assist device modalities.
- CO5** Understand the device working mechanism and current technology used as assist devices
- CO6** Able to demonstrate advanced assist devices

Course Objectives

The students should be made

- To learn the advanced principles of diagnostic and therapeutic modalities.
- Understand the device working mechanism used in critical care
- Understand the devices for the measurements of parameter in operation theatre and dialysis unit.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2									3	1
CO2	2	1	1	2									3	1
CO3	3	1	2	2									2	2
CO4	3	1	2	2									3	1
CO5	3	1	2	2									3	1
CO6	3	2	1	2									3	1

List of Programs

1. Operation and function of all the controls of hospital X-Ray machine & servicing
2. Operation and function of all the controls of Ventilator
3. Study of Arrhythmia monitor.
4. Study of hemodialysis machine
5. Study on apnea monitor
6. Study of heart lung machine model
7. Operation and function of angiography
8. Study of Anesthesia machine.
9. Operation and function of incubator
10. Study of MRI and CT model.

TOTAL: 15 HOURS**Outcomes**

At the end of the course students should be able to

- CO1** Discuss the various extracorporeal and special diagnostic and therapeutic devices used in hospitals
- CO2** Explain about measurements of parameters related to operation theatre and dialysis unit.
- CO3** Understand the working and recording of critical care equipments.
- CO4** To demonstrate the working of haemodialysis machine, anesthesia machine, etc
- CO5** To analyse the operation of MRI and CT
- CO6** To illustrate the operation and function of angiography

SEMESTER VII

U19BMTH710

BIOMECHANICS

L	T	P	C
3	0	0	3

Course Objectives

The students should be made

- Explain the principles of mechanics.
- Discuss the mechanics of physiological systems.
- Explain the mechanics of joints.
- Illustrate the mathematical models used in the analysis of biomechanical systems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3									3	1
CO2	3	3	3	3									3	1
CO3	3	2	1	3									3	1
CO4	3	3	2	3									3	1
CO5	3	3	3	3									3	1
CO6	3	3	2	3									3	1

UNIT I INTRODUCTION TO MECHANICS 9

Introduction – Scalars and vectors, Statics – Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium of coplanar forces, Dynamics, Basic principles – Linear motion, Newton’s laws of motion, Impulse and Momentum, Work and Energy Kinetics – Velocity and acceleration, Kinematics – Link segment models, Force transducers, Force plates, Introduction to Constitutive equations – Constitutive equations of Nonviscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT II BIOFLUID MECHANICS 9

Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers – Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart –Cardiac muscle characterisation, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT III BIOSOLID MECHANICS 9

Constitutive equation of viscoelasticity – Maxwell & Voight models, anisotropy, Hard Tissues – Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hill’s models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS 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.



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Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics – Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Understand the principles of mechanics
- CO2 Outline the principles of biofluid dynamics.
- CO3 Explain the fundamentals of bio-solid mechanics
- CO4 Apply the knowledge of joint mechanics
- CO5 Give Examples of computational mathematical modelling applied in biomechanics.
- CO6 Explain the mechanics of physiological systems

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.

REFERENCES

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, "Biofluid Mechanics: The Human Circulation", Taylor and Francis, 2007.
2. Sheraz S. Malik and Shahbaz S. Malik, "Orthopaedic Biomechanics Made Easy", Cambridge University Press, 2015.
3. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
4. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.
5. Neil J. Mansfield, "Human Response to Vibration", CRC Press, 2005.
6. Carl J. Payton, "Biomechanical Evaluation of movement in sports and Exercise", 2008.

Course Objective

The student should be made:

- Know about the healthcare hazard control and accidents
- Understand biomedical waste management
- Learn the facility guidelines, infection control and patient safety.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3			2	3	3	3	1	2	2	3	1
CO2	3	1	3			2	3	3	3	1	2	2	3	1
CO3	3	1	2			2	3	3	3	1	2	2	3	1
CO4	3	1	3			2	3	3	3	1	2	2	3	1
CO5	3	1	3			2	3	3	3	1	2	2	3	1
CO6	3	1	2			2	3	3	3	1	2	2	3	1

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers' Compensation, Orientation, Education, and Training

UNIT II BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal

UNIT III HAZARDOUS MATERIALS 9

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection

UNIT IV FACILITY SAFETY 9

Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground 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, Healthcare-Associated Infections, Medication Safety



Course Outcomes

At the end of the course students should be able to

- CO1 To understand the technologies of fingerprint, iris, face and speech recognition
- CO2 To analyse the biomedical waste management
- CO3 To recognize the hazardous waste materials in the hospitals
- CO4 To identify the facility safety of the hospital
- CO5 Demonstrate on infection control, prevention and patient safety measures in hospitals
- CO6 Analyze the concepts of healthcare waste management, prevention and control

TEXT BOOK

1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).

REFERENCE BOOK

2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)



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Objectives

The student should be made to

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work;
- Demonstrate patient-care in a hospital setting.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2		2	2	3	3	3	1	2	2	3	
CO2	2	1	1			2	3	3	3	1	2	2	3	
CO3	2	1	2			2	3	3	3	1	2	2	3	
CO4	2	1	1			2	3	3	3	1	2	2	3	
CO5	2	1	1			2	3	3	3	1	2	2	3	
CO6	2	1	2		2	2	3	3	3	1	2	2	3	

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 incharges 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.

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
- 18 Paediatric/Neonatal
- 19 Dental
- 20 Oncology
- 21 PAC's
- 22 Medical Records / Telemetry
- 23 CSSD

Outcomes

At the end of the course, learners will be able to:

- CO1 Advocate a patient-centred approach in healthcare
- CO2 Communicate with other health professionals in a respectful and responsible manner
- CO3 Recognize the importance of inter-professional collaboration in healthcare.
- CO4 Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
- CO5 Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.
- CO6 Demonstrate patient-care in a hospital setting.



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Objective

The student should be made to

- Identify a scientific problem through extensive literature survey.
- Propose solution for the identified problem

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2			3	2	3	2	3	3
CO2	3	3	3	3	2	2			3	2	3	2	3	3
CO3	3	3	3	3	2	2			3	2	3	2	3	3
CO4	3	3	3	3	2	2			3	2	3	2	3	3
CO5	3	3	3	3	2	2			3	2	3	2	3	3
CO6	3	3	3	3	2	2			3	2	3	2	3	3

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 HOURS

Outcomes

At the end of the course students should be able to

- CO1 Effectively review the existing literature
- CO2 Summarize the findings in a coherent manner and identify the problems in existing system
- CO3 Provide solutions for the identified problem using new tools and techniques
- CO4 Write and present a detailed report of their work
- CO5 Manage time and budget effectively
- CO6 Identify the social problems through extensive literature survey and propose a solution for the identified problems

SEMESTER-VIII

UI9BMPRS03

PROJECT WORK – PHASE II

L	T	P	C
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Objective

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2			3	2	3	2	3	3
CO2	3	3	3	3	2	2			3	2	3	2	3	3
CO3	3	3	3	3	2	2			3	2	3	2	3	3
CO4	3	3	3	3	2	2			3	2	3	2	3	3
CO5	3	3	3	3	2	2			3	2	3	2	3	3
CO6	3	3	3	3	2	2			3	2	3	2	3	3

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 HOURS

Outcomes

At the end of the course students should be able to

- CO1** To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- CO2** Develop solutions for the identified problem
- CO3** Use modern techniques to provide solutions
- CO4** Able to prepare project reports and to face reviews and viva voce examination
- CO5** Work as a team and execute their individual responsibilities
- CO6** Present the work in written and oral form



PROFESSIONAL ELECTIVE I

U19BMPE001

**3D PRINTING AND ARTIFICIAL
ORGANS**

L	T	P	C
3	0	0	3

Course Objective

The students should be made

- To become familiar with basic principles of 3D printing (layer by layer)
- To elucidate the methods of 3D bio printing
- To know how to critically evaluate and analyse objects created by 3D-printing for use within the life sciences
- To plan and carry out the project for small 3D printing projects

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2				1					3	1
CO2	3	1	2	2				1					3	1
CO3	3	1	2	2				1					3	1
CO4	3	1	2	2				1					3	1
CO5	3	1	2	2				1					3	1
CO6	3	1	2	2				1					3	1

UNIT I INTRODUCING THE PRINCIPLES, METHODS AND MATERIALS 9

Opportunities & Challenges of 3D bioprinting & bio fabrication in medical applications, Core Principles and Physical Foundations underlying 3D Bioprinting, Basic process of 3D bioprinting: problem, design, material selection, and object fabrication

UNIT II BASICS OF 3D BIOPRINTING AND BIOFABRICATION 9

Development of bio inks; bio printable materials-from metals and ceramics to hydrogels, Medical imaging and imaging processing, Biomodelling, Blueprints -Digital models of tissues and organs, Bioprinters.

UNIT III SOLID, LIQUID AND POWDER BASED PROCESS 9

Principles of stereolithography and typical processes of SLA, solid ground curing, selective laser sintering, fused deposition modelling, laminated object modelling

UNIT IV INKJET TECHNOLOGY 9

Working Principle, Positioning System, Print-head, print bed, Frames, Motion control; Print-head Considerations -Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication -Continuous jet, MultiJet; Powder based fabrication - Color-jet.

UNIT V 3D PRINTING FOR ARTIFICIAL ORGANS 9

Artificial organs: Need and types; Applications of 3D printing in Lab-on-chip and Organ-on-chip Brain-on-chip, Artery-on-a-chip, Lung-on-a-chip, Bone-on-a-chip, Liver-on-a-chip, Gut-on-a-Chip, Applications in prosthetics, Applications in implants, Applications in innovative bioactive research,



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 To introduce the principles of 3D printing
- CO2 To illustrate the methods of 3D bioprinting
- CO3 To be able to know and analyse objects created by 3D printing
- CO4 To learn the process of ink jet technology
- CO5 To explain the key concepts 3D printing in biomedical applications
- CO6 To be able to select materials and design the 3D printing for any biological applications

TEXT BOOKS

1. Design and Modeling for 3D Printing by Matthew Griffin
2. NeelaRajkumar, SK, Kamal PreetSandhu, Vivek Sharma, Applications of 3D printing in Biomedical Engineering. Book DOI: 10.1007/978-981-33-6888-0

REFERENCES

1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2. Christopher Barnatt, 3D printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.

Course Objective

The students should be made

- To become familiar with basic principles of robotics
- To understand the working principles of actuators, sensors and motors
- To learn robotic programming techniques and tools
- To plan and carry out the project for designing a medical robot

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2								2	2
CO2	3	3	3	2	1								2	2
CO3	3	3	3	2	1								2	2
CO4	3	3	3	2	2								2	2
CO5	3	3	3	2	1								2	2
CO6	3	3	3	2	2								2	2

UNIT I INTRODUCTION 9

Introduction to Robotics and its history, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Automation, Mechanisms and movements, Dynamic stabilization- Applications of robotics in medicine

UNIT II ACTUATORS, GRIPPERS AND MANIPULATORS 9

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models, Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator

UNIT III DESIGN OF MEDICAL ROBOTS 9

Characterization of gestures to the design of robots- Design methodologies- Technological choices – Security, Assistive robots –types of assistive robots – case studies

UNIT IV POWER SOURCES AND SENSORS 9

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging – Laser- Acoustic, Magnetic fiber optic and Tactile sensor

UNIT V ROBOTICS IN MEDICINE 9

Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Identify the concepts of robotics, motion, joints
- CO2 Summarize the principles of sensors and actuators for robots and to use the software tools for designing and analyzing the robot motion
- CO3 Classify the performance to various sensors to its environment
- CO4 Recommend the suitable principles for specific conditions and able to create simple robots for surgical applications
- CO5 Identify the concepts of robotics, motion, joints
- CO6 Analyze the principles of sensors and actuators for robots and to use the software tools for designing and analyzing the robot motion

TEXT BOOKS

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, First edition, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008.

REFERENCES

1. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005
2. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011
3. Barbara Webb and Thomas Consi. R, "BioRobotics: Methods & Applications", AAAI Press/MIT Press, First Edition, 2001.



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Course Objective

The students should be made

- 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
- To know the intricacies of these platform to develop PDA applications with better optimality

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	3								2	3
CO2	1	3	3	2	3								3	3
CO3	2	3	3	2	3								2	3
CO4	2	3	3	2	3								2	3
CO5	2	2	3	2	3								2	2
CO6	2	3	3	2	1								2	3

UNIT I INTRODUCTION 9

Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality

UNIT II MULTIPLE MODELS OF INPUT AND OUTPUTS 9

Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices

UNIT III DESIGN OF MEDICAL ROBOTS 9

Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering.

UNIT IV INTERACTIVE TECHNIQUES IN VIRTUAL REALITY 9

Body Track, Hand Gesture, 3D Manus, Object Grasp, Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc.,

UNIT V APPLICATIONS 9

Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Study the primary features and present development on Virtual Reality
- CO2 Summarize the multiple models of input and output
- CO3 Design medical Robots
- CO4 Study interactive techniques in Virtual Reality
- CO5 Apply the concept of VR and AR.
- CO6 Understand augmented reality

TEXT BOOKS

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, First edition, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008.

REFERENCES

1. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005
2. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011
3. Barbara Webb and Thomas Consi. R, "BioRobotics: Methods & Applications", AAAI Press/MIT Press, First Edition, 2001.



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 Explain the basics of MEMS Technology
- CO2 Design and fabricate simple MEM device
- CO3 Compare and explain about the characteristics of MEMs Physical and chemical sensor
- CO4 Classify the biosensors according to its working principle and discuss its application as an implantable device
- CO5 Discuss the various applications of BioMEMS in therapeutics and diagnostics
- CO6 Analyze MEMS techniques

TEXT BOOK

1. Senturia, Stephen, D., "Micro system Design", Kluwer Academic Publishers, 2001.
2. Micro electromechanical system design, James J. Allen. Taylor & Francis 2nd edition.
3. BioMEMS and Biomedical Nanotechnology, volume III Tejal Desai, Sangetha Bhatia.
4. Biomedical Nanotechnology. Neelina H Malsch, Taylor & Francis.

REFERENCE BOOK

1. Lambrechts, M., "Biosensors: Micro electrochemical Devices", CRC Press, 1992.
2. Buerk, Donald, G., "Biosensors: Theory and Applications", CRC Press, 1995.
3. Kovacs, Gregory, "Micro machined Transducers Sourcebook", WCB McGraw-Hill, Boston, 1998.
4. Saliterman Steven, S., "Fundamentals of BioMEMS and Medical Micro devices", Wiley Interscience, SPIE Press Monograph Vol. PM153.



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Course Objective

The students should be made to

- To enable the students to acquire knowledge about the principles and application of Nanotechnology in biomedical industry

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3									3	1
CO2	3	3	3	3									3	1
CO3	3	2	1	3									3	1
CO4	3	3	2	3									3	1
CO5	3	3	3	3									3	1
CO6	3	3	2	3									3	1

UNIT I SYNTHESIS AND APPLICATION OF NANO MATERIAL 9

Bulk synthesis: Top down and bottom up approaches, Inert gas condensation technique, Arc plasma and laser ablation, Chemical synthesis: sol gel processing, hydrothermal, precipitation, spray pyrolysis Electro spraying and spin coating routes, Pulsed electrochemical deposition

UNIT II NANO MATERIAL CHARACTERIZATION TECHNIQUE 9

Introduction to Nano scale phenomena, Nanoparticles determination and carbon nano tube (CNT), Nanomaterial characterization: Scanning electron microscope, (SEM) and Energy-dispersive X-ray spectroscopy (EDS) analysis, Transmission electron microscopy (TEM) analysis and Atomic-force microscopy (AFM) analysis, Scanning probe microscopy (SPM) technique and Small-angle X-ray scattering (SAXS), Nano indentation technique

UNIT III NANOTECHNOLOGY BASED MEDICAL DIAGNOSTICS 9

Introduction to Improved diagnosis by in vivo imaging, Detection of tumors, plaque and genetic defects, Nanobot medical devices, Cantilever Sensors used in biomedical application

UNIT IV PROSTHETIC AND MEDICAL IMPLANTS IN NANOTECHNOLOGY 9

Introduction to prosthesis and implants: Neural implant Ocular, cochlear and dental implants, Implants and prosthesis of skin, limb and bone, Artificial organ and organ transplant, Nanofiber scaffold technology

UNIT V BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY 9

Nano-bio conjugates and their significance, Nanoscaffolds and application, Magnetic



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nanoparticles synthesis and application, Multifunctional inorganic and CNT nano particle and its application, Organic nanoparticles and their biomedical applications

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Learn the different synthesis method and application of nano material
- CO2 Apply the various characterization techniques used in nano biomaterial
- CO3 Know the importance of nanotechnology based biomedical diagnostics
- CO4 Familiarize with biological system, prosthetic and medical implants in nanotechnology
- CO5 Gain the knowledge about nano material used in biomedical application
- CO6 Analyze the different synthesis method and application of nano material

TEXT BOOK

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), "Handbook of Nano Science Engineering and Technology", CRC Press, 2013.
2. K. Barriham, D.D. Vvedensky, "Low dimensional semiconductor structure fundamental and device applications", Cambridge University Press, 2010.

REFERENCE BOOK

1. Cao,G,Nanostructures & Nanomaterials Synthesis: Properties &Applications", Imperial College Press, 2011. Brian, R Eggins; Wiley; New York, Chichester, 3rdedition,2012
2. Allen J Bard and Larry R Faulkner; Wiley, "Electrochemical Methods: Fundamentals and Applications", New York Chichester, 4th edition, 2009
3. David Wild; "The Immunoassay Handbook", Elsevier, 4thedition, 2013.



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Course Objective

The students should be made

- To assimilate the principles and technology used in the design of sustained release and controlled release drug delivery systems
- Introduce the students to the types of drug carriers and methods of preparation
- Comprehend the phenomena regulating mucosal, transdermal, gastro retentive, ocular and IUD drug delivery systems
- Understand the significant gaps and challenges in designing various drug delivery systems.
- Know the clinical and formulation parameters to be considered for drug delivery system design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	3								2	3
CO2	1	3	3	2	3								3	3
CO3	2	3	3	2	3								2	3
CO4	2	3	3	2	3								2	3
CO5	2	2	3	2	3								2	2
CO6	2	3	3	2	1								2	3

UNIT I CONTROLLED AND TARGETED DRUG DELIVERY SYSTEMS 9

Drug delivery routes, Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles, Targeted Drug delivery: concepts, rationale, advantages, disadvantages; Drug carriers: Liposomes, Niosomes, Microspheres, Resealed erythrocytes, Nanoparticles

UNIT II MICRO ENCAPSULATION AND IMPLANTABLE DRUG DELIVERY SYSTEMS 9

Parentral products, Prodrugs, Microencapsulation: Definition, advantages and disadvantages microspheres, microcapsules, microparticles, methods of microencapsulation, applications. Implantable Drug Delivery Systems: concept of implants and osmotic pump

UNIT III MUCOSAL AND IMPLANTABLE DRUG DELIVERY SYSTEMS 9

Mucosal Drug Delivery system: Principles of bioadhesion/ muco-adhesion, transmucosal permeability and formulation considerations of buccal delivery systems. Naso-pulmonary drug delivery system: Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

UNIT IV TRANSDERMAL AND GASTRO-RETENTIVE DRUG DELIVERY SYSTEMS 9



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Transdermal drug delivery systems: Permeation through skin, factors affecting permeation, enhancers of permeation, basic components of TDDS. Gastro-retentive drug delivery systems: approaches for GRDDS- floating, High-density systems, inflatable and gastro adhesive systems.

UNIT V

OCULAR AND IUD DRUG DELIVERY SYSTEMS

9

Ocular drug delivery systems: Intra ocular barriers and methods to overcome, ocular formulations and ocuserts, Intrauterine Drug Delivery Systems: development of intra uterine devices (IUDs) and applications.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

- CO1 Apply the knowledge of bioscience and chemistry to examine the principles of sustained, controlled and targeted drug delivery systems
- CO2 Assess the need for various microencapsulation techniques and implantable drug delivery systems
- CO3 Analyze the phenomena regulating mucosal drug delivery systems and differentiate the formulation considerations for the nasal and pulmonary delivery
- CO4 Identify significant gaps and challenges in designing transdermal and gastro retentive drug delivery systems and propose solutions to overcome it
- CO5 Formulate or design an ocular or intra uterine drug delivery system for given clinical requirements.
- CO6 Apply the knowledge of bioscience and chemistry to examine the principles of sustained, controlled and targeted drug delivery systems

TEXT BOOK

1. Robinson, J. R., Lee V. H. L, "Controlled Drug Delivery Systems", Marcel Dekker, Inc., New York.
2. Vasant V Ranade, Mannfred A Hollinger, "Drug delivery systems", CTC press, second edition
3. Y W. Chien, "Novel Drug Delivery Systems", 2nd edition, Marcel Dekker, Inc., New York.

REFERENCE BOOK

1. S.P. Vyas and R.K. Khar, "Controlled Drug Delivery -concepts and advances", Vallabh Prakashan, New Delhi
2. Jan E Vandegaer, "Micro encapsulation process and application", Plenum press, New york
3. Ambikanandhan Mishra, Aliasagar Shahiwala, "Novel Drug delivery technologies- Innovative strategies for drug repositioning", Springer publications
4. International Journal of Pharmaceutics (Elsevier Sciences)
5. Journal of Controlled Release (Elsevier Sciences)



ASL

Course Outcomes

At the end of the course students should be able to

- CO1 Comprehend and appreciate the significance and role of this course in the present contemporary world.
- CO2 Demonstrate knowledge of the fundamentals of optical properties of tissues.
- CO3 Describe surgical applications of laser.
- CO4 Describe photonics and its therapeutic applications.
- CO5 Apply the concepts of laser and light to understand the laser safety procedures
- CO6 Analyze the optical properties of tissue

TEXT BOOK

1. Markolf H.Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. Paras N. Prasad, "Introduction to Bio photonics", A. John Wiley and sons, Inc. Publications, 2003.

REFERENCE BOOK

1. Tuan Vo Dinh, "Biomedical photonics – Handbook", CRC Press LLC, 2003.
2. Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications", Academic Press, 2006.
3. R. Splinter and B.A. Hooper, "An Introduction to Biomedical Optics", Taylor and Francis, 2007.
4. Helena Jelinkova, "Lasers for Medical Applications: Diagnostics, Therapy and Surgery", Woodhead Publishing, 1st Edition, 2013.



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Course Objective

The students should be made

- To understand the basic ideas related to modeling and different modeling techniques of certain physiological systems.
- To analyze physiological system in time and frequency domain.
- To understand the physical and chemical properties of blood.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2									3	2
CO2	3	3	2	2									3	2
CO3	3	3	2	2									3	2
CO4	3	3	2	2									3	2
CO5	2	2	2	2									3	2
CO6	3	3	2	2									3	2

UNIT I BASIC CONCEPT OF PHYSIOLOGICAL SYSTEMS 9

Systems, Analysis, Examples of physiological control systems, differences between engineering and physiological control systems

UNIT II TIME DOMAIN ANALYSIS 9

Generalized system properties, mathematical approach, electrical analog, linear models, lung mechanics, muscle mechanics, distributed parameter versus lumped parameter models, static analysis, regulation of cardiac output

UNIT III STEADY STATE ANALYSIS OF PHYSIOLOGICAL SYSTEM 9

Blood glucose regulation, chemical regulation of ventilation, electrical model of neural control mechanism Physical, chemical and rheological properties of blood, Dynamics of circulatory system.

UNIT IV MODELLING OF URINE FORMATION 9

Bio chemistry of digestion, types of heat loss from body, models of heat transfer between subsystem of human body like skin core, etc. and systems like within body, body environment, Transport through cells and tubules, diffusion, facilitated diffusion and active transport, method soft waste removal, counter current model of urine formation in nephron, Modeling Henle's loop.

UNIT V MODELLING OF BLOOD FLOW 9

Modeling oxygen up take by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanism of lungs, oxygen and carbon dioxide transport in blood and tissues.

TOTAL: 45 HOURS



Course outcomes

At the end of the course students should be able to

- CO1 Develop mathematical model of physiological system.
- CO2 Simulate the physiological system and analyze in time and frequency domain
- CO3 Apply system identification and optimization concepts in modeling
- CO4 Understand modelling of urine formation
- CO5 Analyze modelling of blood formation
- CO6 Understand physical and chemical properties of blood.

TEXT BOOK

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

REFERENCE BOOK

1. David.O.Cooney, "Biomedical Engineering Principles" Marcel Decker Pub.Co.2000
2. John Enderly, Susan Blanchard, Joseph Bronzino. "Introduction to Biomedical Engineering", Second Edition, Academic Press Series in Biomedical Engineering, 2005.



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Course objective

The student should be made:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To study the technologies of fingerprint, iris, face and speech recognition.
- To study of evaluation of biometrics systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1								2	3
CO2	3	2	2	1	1								2	3
CO3	3	3	3	1	1								2	3
CO4	3	2	2	1	1								2	3
CO5	3	2	2	1	1								2	3
CO6	3	2	2	1	1								2	3

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 HOURS

Course Outcomes

At the end of the course students should be able to

- CO1 To understand the technologies of fingerprint, iris, face and speech recognition
- CO2 To understand the general principles of design of biometric systems and the underlying trade-offs.
- CO3 To recognize personal privacy and security implications of biometrics based identification technology.
- CO4 To identify issues in the realistic evaluation of biometrics based systems
- CO5 Demonstrate knowledge engineering principles underlying biometric systems.
- CO6 Analyze design basic biometric system applications.

TEXT BOOK

1. James Wayman & Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.

REFERENCE BOOK

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. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003.



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PROFESSIONAL ELECTIVE IV

U19BMPE010

**BODY AREA NETWORKS AND
MOBILE HEALTHCARE**

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Course Objective

The student should be made:

- Objective of the course on body area network and mobile healthcare for biomedical engineering students is to provide an overview of the technical background of Body Area Networks (BAN) and its application in health care using mobile technology

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3									3	1
CO2	3	3	3	3									3	1
CO3	3	2	1	3									3	1
CO4	3	3	2	3									3	1
CO5	3	3	3	3									3	1
CO6	3	3	2	3									3	1

UNIT I **BAN INCEPTION** **9**

BAN and healthcare- Technical challenges- sensor design- Biocompatibility, energy supply, energy scavenging methods- Optimal node placement, number of nodes, networks for BAN- System security and reliability, standards- BAN Architecture

UNIT II **HARDWARE FOR BAN** **9**

Processor-Low Power MCUs, mobile computing MCUs- Integrated processor with radio transceiver, memory types and ranges- Antenna types, PCB antenna, wire antenna, ceramic antenna, external antenna- Sensor interface, power sources- batteries and fuel cells for sensor nodes.

UNIT III **WEARABLE SENSORS AND STANDARDS FOR BAN** **9**

Wearables fundamentals and role of wearable sensors- Attributes of wearables, flexible electronics, meta-wearables- Future of wearables, research road map- Wireless personal area network technologies-IEEE 802.15.1, IEEE 802.15.13, IEEE 802.15.14- Zigbee, coexistence issues with BAN.

UNIT IV **MOBILE DEVICES FOR HEALTHCARE** **9**

Wearable system for ECG monitoring- Evaluation of night time performance, smart phone based health care monitoring system- Phone based fall risk prediction- RFID based personal mobile medical assistance- Secure medical sensor network.

UNIT V **MOBILE HEALTH TECHNOLOGIES AND APPLICATIONS** **9**

Mobile nutrition tracking -case study- Accessing existing virtual electronic patient record, mobile personal health records- Monitoring hospital patients, sensing vital signs and transmission using wireless networks- Context aware healthcare applications with case study.



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Course Outcomes

At the end of the course, learners will be able to:

- CO1 Comprehend technical information and challenges in body area networks (BAN)
- CO2 Describe the hardware requirements of BAN
- CO3 Review the wearable sensors and standards for BAN
- CO4 Describe the medical devices that are available for health care
- CO5 Summarize the possible and latest applications of mobile healthcare
- CO6 Analyse the application in health care using mobile technology

TEXT BOOKS

1. Philip Olla, Joseph Tan, "Mobile Health solutions for Biomedical applications", Medical Information science reference, Hershey New York, IGI Global 2009.
2. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation, and applications", Pan Stanford Publishing Pvt.Ltd, Singapore, 1st edition, 2012.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 1st edition, 2011.

REFERENCES

6. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 1st edition, 2013
7. Guang-Zhong Yang (Ed.), "Body Sensor Networks", Springer, 1st edition, 2006.
8. Konstantina S. Nikita, James C. Lin, Dimitrios, Maria Teresa, "Wireless mobile communication and healthcare", Second International ICST conference, Mobihealth 2011, Springer, 1st edition, 2011.
9. Ullah, Sana, et al. "A review of wireless body area networks for medical applications", Int'l J. of Communications, Network and System Sciences 2.08 (2009): 797.
10. Patel, Shyamal, et al. "A review of wearable sensors and systems with application in rehabilitation", Journal of Neuroengineering Rehabilitation. 9.12 (2012): 1-17.
11. Edward Sazonov, Michael R Neuman, "Wearable sensors: Fundamentals, Implementations and applications" Elsevier, 1st edition, 2014



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Course Objective

The student should be made:

- To prepare the students in development, implementation, and use of modern health care information systems.
- To provide knowledge in interdisciplinary and integrated approach to health care IT.
- To study both the fundamental concepts and the cutting-edge IT technologies used in the design, implementation, and management of health care IT applications

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3									3	1
CO2	3	3	3	3									3	1
CO3	3	2	1	3									3	1
CO4	3	3	2	3									3	1
CO5	3	3	3	3									3	1
CO6	3	3	2	3									3	1

UNIT I MEDICAL INFORMATICS 9

Introduction – Medical Informatics – Bioinformatics – Health Informatics – Structure of Medical Informatics -Functional capabilities of Hospital Information System – On-line services and off – line services – History taken by computer, Dialogue with the computer. Clinical Informatics, imaging Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital, Consumer Health Informatics and Healthcare Data Analytics.

UNIT II ELECTRONICS PATIENT RECORDS AND STANDARDS 9

Electronic Patient Record, Medical data formats, – Medical Standards and Organizations – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED – JCAHO – HIPAA.

UNIT III MEDICAL DATA ACQUISITION AND STORAGE 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 JAVA PROGRAMMING 9

Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL. Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation – Radiation therapy and planning – Telemedicine – virtual Hospitals – Smart Medical Homes



Course Outcomes

At the end of the course students should be able to

- CO1 Explore how technology can be used to improve health care delivery in health care organizations and in public health.
- CO2 Acquire breadth of knowledge of the principles of health informatics.
- CO3 Develop basic skills in using health informatics principles to improve practice.
- CO4 Acquire a conceptual and theoretical framework of the design, development, and implementation of health information systems.
- CO5 Programming skills in Java and script languages
- CO6 Obtain knowledge in interdisciplinary and integrated approach to health care IT.

TEXT BOOK

1. R.D.Lele, "Computers in Medicine: Progress in Medical Informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2003.
3. N.Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd – New Delhi, 2007.
4. Yi – Ping Phoebe Chen, "Bioinformatics Technologies", Springer International Edition, New Delhi, 2007.

REFERENCE BOOK

1. Robert E Hoyt, Ann Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, 6th Edition, lulu.com, 2014.
2. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
3. Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005.
4. Yi-Ping Phoebe, Bioinformatics Technologies, Springer International, New Delhi, 2007.
5. Orpita Bosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007.
6. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
7. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005



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Course Objective

The student should be made:

- To introduce concepts of materials and interaction of surface towards biomaterials.
- To learn about the polymeric materials and composites in tissue replacements.
- To study the various techniques involved in controlling the microbial growth on the surfaces.
- To understand diverse elements controlling biological responses to materials.
- To know the compatibility and functioning of artificial organs inside the living system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2				1					3	2
CO2	3	1	2	2									2	1
CO3	3	1	2	2				1					3	1
CO4	3	1	2	2				1					3	1
CO5	3	1	1	2				1					3	1
CO6	3	2	2	2				1					3	1

UNIT I INTRODUCTION

9

Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

UNIT II MATERIALS IN MEDICAL DEVICES

9

Metals, Ceramics, Polymers and Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERILIZATION OF BIOMATERIALS

9

Sterilization techniques: Process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization.

UNIT IV TESTING OF MATERIALS

9

Testing with Tissue Culture – in vitro and in vivo assessment of biocompatibility, Testing with Soft Tissues and testing at non Thrombogenic surface – blood compatibility and thrombogenicity, ISO 10993- standard for assessment of biocompatibility.

UNIT V HARD AND SOFT REPLACEMENT

9

Cardiac Implants, Orthopedic Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses.

TOTAL: 45 HOURS

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Course Outcomes

At the end of the course students should be able to

- CO1 Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials 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 Understand the testing standards applied for biomaterials
- CO6 Familiarize with the significance of biomaterials and its categories

TEXT BOOK

1. J.H.U.Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F.Von Racum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.

REFERENCE BOOK

1. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering,2005.
2. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine,2nd Edition, Elsevier Academic Press, San Diego, 2004.



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U19BMPE013

ENTREPRENEURSHIP IN BIOMEDICAL ENGINEERING

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Course Objectives

The student should be made to:

- To learn fundamentals of entrepreneurship
- To apply the methods of entrepreneurship in medical field
- To evaluate the medical devices and market trends

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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			
CO6						2	2	2	2	2	2			

UNIT I SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP 9

Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

UNIT II VENTURE 9

Assessing the venture, Establish venture invention, market research, presenting the business plan, case study.

UNIT III REGULATIONS 9

Certification, ISI, CE, UL, NABL and FDA regulations, ISO:13485, ISO:14791, risk management, Environmental regulation. Case study on risk management. Case study.

UNIT IV IDENTIFYING THE GRANTS 9

Identify and organize support for product development, funding agencies, collaborative initiatives, and angel investors.

UNIT V IMPACT OF GLOBALIZATION AND ENVIRONMENTAL AWARENESS 9

Medical product manufacturing, marketing, leadership, quality management. Environmental regulations, safety, safe disposal, preventing pollution, preventing health hazards.

TOTAL: 45 PERIODS



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Course Outcomes

At the end of the course students should 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
- CO5 Judge the right product based on market needs
- CO6 Compile and quantify the opportunities and challenges

TEXT BOOK

1. Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA, 2010.
2. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersey, 2016.

REFERENCE BOOK

1. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014.



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Course Objective

The student should be made:

- Achieve familiarity with some basic ethical framework & understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- To know about the legal and ethical principles and application of these in medical field.
- Gain knowledge about the medical standards that to be followed in hospitals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2			3	2	3	2	3	3
CO2	3	3	3	3	2	2			3	2	3	2	3	3
CO3	3	3	3	3	2	2			3	2	3	2	3	3
CO4	3	3	3	3	2	2			3	2	3	2	3	3
CO5	3	3	3	3	2	2			3	2	3	2	3	3
CO6	3	3	3	3	2	2			3	2	3	2	3	3

UNIT I**INTRODUCTION**

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

UNIT II**ETHICAL THEORIES AND MODERN PRINCIPLES**

9

Theories-Deontology & Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles - Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice.

UNIT III**ETHICAL ISSUES IN BIOMEDICAL RESEARCH**

9

Bioethical issues in Human Genetics and Reproductive Medicine, Hospital accreditation standards, Accreditation- JCI Accreditation & its Policies, Patient centered standards, Healthcare Organization, management standards

UNIT IV**HOSPITAL SAFETY STANDARDS**

9

Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment

UNIT V**PROFESSIONAL ETHICS AND DEVELOPMENT MODULE**

9

Concept of professionalism and ethics among health care professionals and consequences of unprofessional and unethical behavior, Nature of physician's work considering core values like compassion, altruism, integrity, duty, responsibility, trust, Value, honesty and respect during interaction with peers, seniors, faculty, other health workers and patients, significance of working in a healthcare



Course Outcomes

At the end of the course students should be able to

- CO1 Achieve familiarity with some basic ethical framework & understand how these ethical frameworks can help us to think through contemporary questions in medical ethics
- CO2 To know about the legal and ethical principles and application of these in medical field
- CO3 To understand ethical issues in biomedical research
- CO4 Gain knowledge about the medical standards that to be followed in hospitals
- CO5 To analyse the concepts of professionalism and ethics in medical practice
- CO6 Maintain the confidentiality issues in medical practice

TEXT BOOK

1. William Charney, "Handbook of Modern Hospital Safety", CRC Press, 2nd edition, 2009
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, Zijad Dzemic, "Inspection of Medical Devices: For Regulatory Purposes", Springer Nature, 2018.
3. Domiel A Vallero, "Biomedical Ethics for Engineers", Elsevier Pub., 1st Edition, 2007.

REFERENCE BOOK

1. Eileen E. Morrison, Jonnes and Bartletts, "Ethics in Health Administration: A Practical Approach for Decision Makers," Publication, 2nd Edition, 2011.
2. Robert M Veatch, "Basics of Bio Ethics", Prentice- Hall, Inc., 2nd Edition, 2003.
3. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HC Pro, Inc., 2010.



Course Objective

The student should be made:

- Understand the theory of IR Thermography
- Study the applications of IR Thermography

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	2	2							3	1
CO2	3	3	3	3	2	2							3	3
CO3	1	3	3	3	2	1							3	2
CO4	3	3	3	1	2	2							3	3
CO5	3	3	3	3	2	2							3	3
CO6	3	2	2	3	2	2							3	3
UNIT I	IR THERMOGRAPHY – THEORY AND PHYSICS													9

History and evolution of thermography, blackbody radiation laws, IR absorption characteristics, radiometric measurements, heat and temperature, heat transfer mechanism, temperature measurement.

UNIT II**IR THERMOGRAPHY SYSTEM - COMPONENTS****9**

Optics, IR detector, detector performance parameters, image formation, filters, calibration, detector selection, choice of spectral band.

UNIT III**IR THERMOGRAPHY SYSTEM – DESIGN AND ADVANCED METHODS****9**

Camera performance characterization, temperature accuracy, temperature resolution, spatial resolution, time resolution, image quality. Advanced Methods: Spectrally Resolve IR Imaging, Super framing, Image processing and IR Imaging Software, Recent Advances

UNIT IV**IR THERMOGRAPHY APPLICATIONS- PASSIVE****9**

Introduction, condition monitoring, building inspection, process monitoring and control, night vision and surveillance, medical applications, aircraft monitoring, automobile industry.

UNIT V**THERMOGRAPHY APPLICATIONS - ACTIVE****9**

Active thermography techniques, inspection of composites, thermal property measurement, defect detection, characterization of coatings, corrosion detection, thermo mechanics.

TOTAL: 45 HOURS

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Course Outcomes

At the end of the course students should be able to

- CO1 Understand the theoretical background of Infrared Thermography and temperature.
- CO2 Understand the complete IR thermography system and its working principle.
- CO3 Analyze and use the advanced concepts of IR thermography system.
- CO4 Understand the concepts of IR camera operation and choose proper IR imaging system for a given problem.
- CO5 Apply IR thermography techniques for various engineering related problems
- CO6 Acquire knowledge in condition monitoring

TEXT BOOK

1. Michael Vollmer, Klaus-Peter Mollmann, Infrared Thermal Imaging: Fundamentals, Research and Applications, John Wiley, 2010.
2. Holst, Gerald C. Common sense approach to thermal imaging. Washington, DC, USA: SPIE Optical Engineering Press, 2000.

REFERENCE BOOK

1. Xavier P.V. Maldague, Nondestructive Evaluation of Materials by Infrared Thermography, Springer Science & Business Media, 2012.
2. Kaplan, Herbert. Practical applications of infrared thermal sensing and imaging equipment. Vol. 75. SPIE press, 2007.



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Course Objectives

The student should be made to:

- Provide a source of useful ideas, concepts, and techniques that could be selectively applied to reduce an intolerable rate of unacceptable errors, mistakes, goofs, or short comings in expected Medical Device performance.
- Understand the principle of safety and risk management for avoiding patient injury.
- Study the various Medical Devices Standards, Regulations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2										1	
CO2	2	2	2										1	
CO3	2	2	2										1	
CO4	2	2	2										1	
CO5	2	2	2										1	
CO6	2	2	2										1	

UNIT I BASICS OF RELIABILITY AND CONCEPT OF FAILURE 9

Reliability and Safety Testing: Reliability – Types of reliability – Reliability optimization & assurance – Reliability’s effect on medical devices – The concept of failure – Causes of failure – Types of Failures in Medical devices – Safety testing – Device specific safety goals.

UNIT II SAFETY AND RISK MANAGEMENT 9

Failure assessment and Documentation – Visual inspection: External & Internal visual inspection – Measurement – Safety parameters, Function test - Risk Management: Safety and risk management – Risk, Deciding on acceptable risk, Factors important to medical device risk assessment – Risk management – Tools for risk estimation – Liability – Manufacturer’s and physician’s responsibilities.

UNIT III ENVIRONMENTAL AND ECOLOGICAL SAFETY 9

Devices Handling, Environmental & Ecological Safety: Safe medical devices – Handling and operation – Medical Application safety – Usability – Clinical assessment – Environmental safety – Interference with the environment – Environmental conditions, Impact on the environment – Ecological safety – Bioethics.

UNIT IV MECHANICAL AND ELECTRICAL SAFETY 9

Mechanical and Electrical Safety: Safety Mechanics – Electrical Safety – Biological aspect – Limitation of Voltages - Macroshock and Microshock – Earth and Protection – Leakage currents – Magnetic fields and compatibility – Basic assumptions in safety technology – Safety classes

UNIT V MEDICAL DEVICES STANDARDS, REGULATIONS 9

Medical Standards and Regulations – Device classification – Registration and listing – Declaration of conformance to a recognized standard – Investigational Device Exemptions (IDEs) – Institutional



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Review Boards (IRBs) – IDE format – Good laboratory practices (GLPs) – Good manufacturing practices (GMPs) – Human factors – Design control.

TOTAL: 45 PERIODS

Course Outcomes

At the end of the course students should be able to

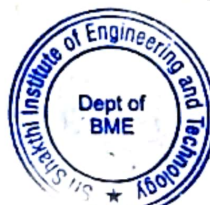
- CO1 Identify the mechanical and electrical safety standards of medical equipment
- CO2 Understand device specific safety goals
- CO3 Interpret reasonable, acceptable and effective remedies.
- CO4 Assess the clinical suitability to under the impact of the device on the environment
- CO5 Design more reliable medical equipment incorporating safety goals
- CO6 Suggest new techniques for device management

TEXT BOOK

1. Richard Fries, "Reliable Design of Medical Devices – Second Edition", CRC Press, Taylor & Francis Group, 2006.
2. Norbert Leitgeb "Safety of Electro-medical Devices Law – Risks – Opportunities" Springer Verlag/Wein, 2010.

REFERENCE BOOK

1. Bertil Jacobson and Alan Murray, "Medical Devices Use and Safety", Elsevier Limited, 2007.
2. Gordon R Higson, "Medical Device Safety – The regulation of Medical Devices for Public Health and Safety", IOP Publishing Limited, Bristol and Philadelphia, 2002.
3. Shayne Cox Gad, "Safety Evaluation of Medical Devices" Second Edition, Marcel Dekker Inc., 2002.
4. Case Studies of Medical Device Adverse Events, Saudi Food and Drug Authority, 2007
5. Michael Wiklund, Jonathan Kendler, Alison Strohlic, "Usability Testing of Medical Devices", Second edition, CRC Press, Taylor and Francis Group, 2015



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U19BMPE017

MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING

L T P C
3 0 0 3

Course Objectives

The student should be made to:

- Understand troubleshooting of electrical and electronic equipment.
- Learn the troubleshooting of medical equipment.
- Apply the tools in design, testing and developing medical equipment

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2										1	
CO2	2	2	2										1	
CO3	2	2	2										1	
CO4	2	2	2										1	
CO5	2	2	2										1	
CO6	2	2	2										1	

UNIT I TESTING OF ELECTRICAL EQUIPMENTS 9

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires -Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipment and instruments.

UNIT II TESTING OF ELECTRONIC COMPONENTS 9

Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Powersupply design, testing, Safe electrical practice, Cables and standard, Fuse.

UNIT III TESTING OF SURGICAL EQUIPMENT 9

Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

UNIT IV TROUBLESHOOTING OF EQUIPMENTS 9

X-ray machines, Troubleshooting of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

UNIT V LIFE CYCLE MANAGEMENT OF MEDICAL EQUIPMENT 9

Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle. Case study.

TOTAL: 45 PERIODS



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Course Outcomes

At the end of the course students should be able to

- CO1 Identify the reasons for equipment failure.
- CO2 Interpret the need for grounding aspects, maintenance and troubleshooting.
- CO3 Construct the test bench, tools and methods for troubleshooting
- CO4 Compare various standards and specifications.
- CO5 Decide quality and safety standards
- CO6 Formulate advanced methods to solve critical problems.

TEXT BOOK

1. B.S. Dhillon, "Medical Device Reliability and Associated Areas", CRC Press, UK, 2000.
2. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley&Sons, New York,4thedition, 2008.
3. Keith Willson, Keith Ison, Slavik Tabakov, "Medical equipment management", CRC Press, UK,2014.

REFERENCE BOOK

1. Jenny Dooley,John Lehnert Virginia Evans, "Career Paths: Medical Equipment Repair", ExpressPublishing, UK,2018
2. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation systems", Cengage LearningTechnology & Engineering, 2010.
3. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment",McGraw Hill Professional edition, 2013.
4. R. S. Khandpur, "Troubleshooting Electronic Equipment" 1st Edition, McGraw Hill, 2007



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U19BMPE018

**HOSPITAL DESIGN AND EQUIPMENT
MANAGEMENT**

L T P C
3 0 0 3

Course Objectives

The student should be made to:

- Understand the fundamentals of health care delivery services
- Learn the procedures in maintenance of equipments
- Apply the design principles in engineering systems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2						1				1	
CO2	2	2	2						1				1	
CO3	2	2	2						1				1	
CO4	2	2	2						1				1	
CO5	2	2	2						1				1	
CO6	2	2	2						1				1	

UNIT I HEALTH AND HOSPITAL MANAGEMENT 9

Health organization of the country, the State, the Cities and the Region, Management of Hospital organization, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Team Work, Legal aspect in Hospital Management. Case study: Health survey.

UNIT II REGULATORY AND VOLUNTARY GUIDELINES AND HEALTH CARE CODES 9

FDA Regulation, Joint Commission on Accreditation for Hospitals, National Fire Protection Association Standard, ISO, NABL, ISO:13485, ISO:14791, risk management, Environmental regulation. Case study on risk management

UNIT III HEALTHCARE SUPPLY CHAIN MANGEMENT 9

Essentials of healthcare supply chain management, designing sustainable health care supply chain, performance metrics, emerging trends in healthcare supply chain management.

UNIT IV CLINICAL ENGINEERING 9

Role to be performed in Hospital, Manpower & Market, Professional Registration, Maintenance of Hospital support system, surveillance network, electric power management, Medical gas production, waste disposal, inventory control. Case study: RF ID tag for inventory.

UNIT V SAFETY EQUIPMENTS 9

Operation of safety devices, personnel safety equipments, Gas mask, Radiation measurements, equipment safety systems, elements of basic first aid, fire fighting, Case study: Safety Awareness.

TOTAL: 45 PERIODS



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Course Outcomes

At the end of the course students should be able to

- CO1 Identify the principle of organizational structures and regulatory services
- CO2 Classify the types of codes followed and applications
- CO3 Modify the design to develop support systems
- CO4 Infer the most challenges in environment and market trends
- CO5 Evaluate the systems based on the safety criteria to environment
- CO6 Create the methodology for new equipments to user needs

TEXT BOOK

1. Hokey Min, "Healthcare Supply Chain Management: Basic Concepts and principles", Business expert press, NewYork, 2014
2. Keith Willson, Keith Ison, Slavik Tabakov, "Medical Equipment Management", CRC Press, 2013
3. Webster.J.G. and Albert M.Cook, "Clinical Engineering Principles and Practices Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979.

REFERENCE BOOK

1. Robin Guenther, Gail Vittori, "Sustainable Healthcare Architecture", Wiley, 2013.
2. Sharma D K, R.C.Goyal, "Hospital administration and human Resource Management in Hospital", Prentice Hall of India, New Delhi, 2017
3. Syed Amin Tabish "Hospital and Health services Administration Principles and Practices" Oxford

U19BMPE019

MEDICAL INTERNET OF THINGS

L T P C
3 0 0 3

Course Objective

The student should be made:

1. Impart necessary and practical knowledge of components of Internet of Things
2. Gain Knowledge on IoT protocols
3. Deal with case studies related to healthcare applications of IoT.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2										1	
CO2	2	2	2										1	
CO3	2	2	2										1	
CO4	2	2	2										1	
CO5	2	2	2										1	
CO6	2	2	2										1	

UNIT I INTRODUCTION TO IOT 9

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT, Wireless Body Area Networking.

UNIT II ELEMENTS OF IOT 9

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT III IOT APPLICATION DEVELOPMENT 9

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT IV BUILDING IOT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDY/HEALTH CARE 9

IoT in Emergency and Healthcare services, Components of IoT healthcare, Remote health care, Real time monitoring, Preventive care, Preventive Cardiological Monitoring, Health care systems- Activity Monitoring



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Course Outcomes

At the end of the course students should be able to

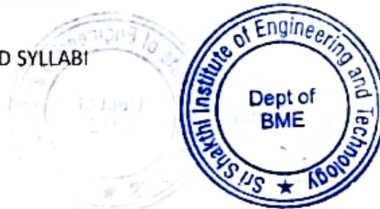
- CO1 Understand internet of Things and its hardware and software components
- CO2 Interface I/O devices, sensors & communication modules
- CO3 Remotely monitor data and control devices
- CO4 Develop understanding of data analytics and supporting devices
- CO5 Discuss about Case studies on IoT applications in health care
- CO6 Develop real life IoT based medical applications

TEXT BOOK

1. A Handbook of Internet of Things in Biomedical and Cyber Physical System, **Bālaş, V.E., Solanki, V.K., Kumar, R., Ahad**, ISBN 978-3-030-23983-1, 2019
2. Medical Internet of Things, Hamed Farhadi, Intech Open, 2019.
3. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
4. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madiseti (Universities Press)
5. Raspberry Pi Iot in C, Harry Fairhead , 1st edition, 2016, I/O Press,, ISBN-13: 978-1871962468.

REFERENCE BOOK

1. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madiseti (Universities Press)
2. **Bālaş, V.E., Solanki, V.K., Kumar, R., Ahad**, "A Handbook of Internet of Things in Biomedical and Cyber Physical System" , ISBN 978-3-030-23983-1, 2019
3. Vijay Madiseti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press, 2018
4. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2-17
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017



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UI9BMPE020

CLINICAL MICROBIOLOGY

L T P C
3 0 0 3

Course Objective

The student should be made:

- To study about the introduction of Fungi
- To learn the Structure and Etiology
- To understand the Classification of Animal Viruses
- To know the detailed study
- To learn the types of Disorders in Red Blood Cell

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2										1	
CO2	2	2	2										1	
CO3	2	2	2										1	
CO4	2	2	2										1	
CO5	2	2	2										1	
CO6	2	2	2										1	

UNIT I INTRODUCTION TO FUNGI 9

Classification of Medically important fungi. General identification process of medically important fungi.

UNIT II ETIOLOGY 9

Detailed study about etiology, Lab diagnosis, Pathogenesis and Treatment of Superficial *Trichophyton* Systemic (Candidiosis) diseases of human.

UNIT III CLASSIFICATION OF ANIMAL VIRUSES 9

Classification of animal viruses. Isolation, Identification, Cultivation and Purification of animal viruses. Antiviral chemotherapy. Viral Zoonotic infection. Viral vaccines. Interferons.

UNIT IV DNA VIRUSES 9

DNA viruses- Poxvirus, Herpes virus, Adeno virus, Hepatitis B virus.

UNIT V RNA VIRUSES 9

RNA viruses – Retrovirus, Picorna virus, Reo virus, Herpes virus, Rhabdo virus, Toga virus, Paramyxo virus



Course Outcomes

At the end of the course students should be able to

- CO1 Understand the theoretical background of General virology and myology
- CO2 Understand the complete Etiology
- CO3 Analyze and use the advanced concepts of animal viruses.
- CO4 Understand the concepts of RNA viruses
- CO5 Apply for various classification of animal viruses and related problems
- CO6 Acquire knowledge in DNA Viruses

TEXT BOOK

1. Richman, Whitley, Hayden. Clinical virology. Churchill Livingstone, New York. 1997.
2. David. M.Knipe & Peter M.Harley. Fundamental Virology, 4th Ed., Lippincott Williams & Wilkins, 2001.

REFERENCE BOOK

1. " S.J. Flint Enguist, L.W. Krug RM, Racaniello V.R., A.M.Skalka. Principles of Virology, A.S.M. Press, Wasington, 2000.



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OPEN ELECTIVE I

B.TECH AGRICULTURAL ENGINEERING

U19AEOE001

**AGRICULTURAL WASTE
MANAGEMENT**

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge to students on various methods of agricultural waste management foreco-friendly energy and manure production.

PREREQUISITES: NIL

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1											
CO2	3	2	2											
CO3	2	1	1											
CO4	2	1	1											
CO5	2	1	1											
CO6	2	1	1											

UNIT I

INTRODUCTION

10

Availability of different types of agriculture wastes - its overall characteristics - classification of agro wastes based on their characteristics- its recycling and utilization potential- current constraints in collection and handling of agricultural wastes - its environmental impact.

UNIT II

COMPOSTING

8

Definition- Solid waste suitable for composting - Methods of composting - vermicomposting - Mineralization process in composting - Biochemistry of composting - Factors involved - Infrastructure required - maturity parameters - value addition - application methods

UNIT III

BIOMASS BRIQUETTING

9

Definition - potential agro residues and their characteristics for briquetting - fundamental aspects and technologies involved in briquetting - economic analysis of briquetting - setting up of briquetting plant- appliances for biomass briquettes.

UNIT IV

BIOCHAR PRODUCTION

9

Definition - characteristics of agro wastes suitable for Biochar production - Methods of Biochar production - fast and slow pyrolysis - characteristics of Biochar - role of Biochar in soil nutrition and carbon sequestration

BME REGULATION 2019 CURRICULA AND SYLLABUS



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Screening of suitable ligno cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids - Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from ligno cellulosic wastes - Processing of Biomass to Ethanol –pre-treatment-fermentation-distillation

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1 Build various eco-friendly methods for agricultural waste management
- CO2 To develop the process of composting of different types of solid wastes
- CO3 To understand the techniques of briquetting from agro-residues
- CO4 To understand the role of biochar in soil nutrition and carbon sequestration
- CO5 Nutritive value and energy production potential of agro wastes
- CO6 To develop and understand the techniques for processing of ethanol and biogas production

TEXT BOOKS:

- T1: Rai G.D, Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
- T2: Diaz, I.F., M. de Bertoldi and W. Bidlingmaier. 2007. Compost science and technology, Elsevier pub., PP.1-380.

REFERENCE BOOKS:

- R1: P.D. Grover & S.K. Mishra, "Biomass Briquetting: Technology and Practices". Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
- R2: Magdalena Muradin and Zenon Foltynowicz, "Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland". Sustainability, 2014, 6, 5065-5074.
- R3: Biochar production from agricultural wastes via low-temperature microwave carbonization



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COURSE OBJECTIVES

- To impart the fundamental knowledge and basic concepts of Economics and Farm Management
- To understand the types of resources and Investment analysis in agriculture sector
- To understand the Farm financial analysis, Investment and Budgeting for farms.
- To expose the students to different extension methods for communication to take the work from lab to field
- To plan the financial aspects, economics related to farm management in a cost effective manner.

PREREQUISITES: NIL

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3													
CO3	3	2	2	2										
CO4	3	2	2	2										
CO5	3	3	2	2										1
CO6	2	3	2	1										1

UNIT I FARM MANAGEMENT & PLANNING 10

Farm Management – definition – scope- Classification of farms – Basic concepts in farm management -Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts– Farm appraisal techniques – Valuation - Farm management- need and analysis –Elements of farm planning– Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting

UNIT II LAWS OF ECONOMICS 8

Agricultural Economics – definition and scope – Basic laws of economics – demand and supply concepts –law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship –Production function – definition and types – Production function curves – Optimum level of input use –Economies of scale external and internal economies and diseconomies - Cost concepts – types – Opportunity cost – comparison of costs – Factor relationship – concepts.

UNIT III COST CURVES 10

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combination of inputs-Product-product relationship – Production possibility curve, isorevenue line and optimum combination of outputs – Cost curves –Optimum input and output levels –Factor &relationship – Least cost combination of inputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops



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Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis –Investment analysis – Discounting techniques- Farm financial analysis – Balance sheet – Income statement –Cash flow analysis – Farm investment analysis – Time comparison principles - Preparation of interview schedule and farm visit for data collection.

UNIT V

AGRICULTURAL EXTENSION

8

Communication – models – elements and their characteristics – types and barriers - Programme planning – monitoring and evaluation - Extension teaching methods - Audio-Visual aids – classification – purpose, planning and selection – individual, group and mass contact methods – Modern communication sources –internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone – Diffusion - Adoption –Capacity building of extension personnel and farmers –types of training, training to farmers, farm women and rural youth, FTC & KVK.

Total:45HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1 Gain knowledge in various farm management and farm layout aspects
- CO2 familiarize with the various laws of economics and product relationship aspects
- CO3 gain knowledge on cost curves and its applications
- CO4 Understand about the various concepts of management of resources
- CO5 Gain knowledge on farm management and financial analysis
- CO6 Familiarize with budgeting and cost estimation for farm layout

TEXT BOOKS:

- T1: Johl, S.S., and Kapur, T.R., "Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007
- T2: Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani S. Devi, I., "Agricultural Economics" Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCE BOOKS:

- R1: Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
- R2: Subba Reddy, S., and Raghu Ram, P., "Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.



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UNIT V IMPLEMENTATION OF TELEMEDICINE AND FUTURE TRENDS IN TECHNOLOGY

9

Telecardiology: Tools and devices Teleradiology and Tele-audiology Telepathology system development and implementation Acute care telemedicine and monitoring for elderly care Virtual doctor systems for medical practices, wireless electrical impedance tomography Synthetic biometrics in biomedical systems, bio-kinematics for mobility

Total:45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1: Explain the development and transmission techniques used in telemedicine
- CO2: Describe the types of communication and network systems
- CO3: Explain the technologies used in data exchange and privacy of telemedicine
- CO4: Illustrate the current system of tele-health and mobile health
- CO5: Describe the currents and futures perspective of telemedicine
- CO6: Acquire knowledge about the principles and application of telemedicine

TEXTBOOKS:

- T1 Bernard Fong, A.C.M. Fong, C.K. Li, -Telemedicine Technologies: Information Technologies in Medicine and Telehealth, Wiley, 1st edition,2010.
- T2 Halit Eren, John G. Webster, -The E-Medicine, E-Health, M-Health, Telemedicine, and Telehealth Handbook, CRC Press, 1st edition, 2015.
- T3 Olga Ferrer-Roca, M. Sosa Ludicissa, -Handbook of Telemedicine, IOS press, 1st edition, 2002.

REFERENCE BOOKS:

- R1 Georgi Grashew, Stefan Rakowsky, -Telemedicine Techniques and Applications, In Tech, 1st edition, 2011
- R2 A.C. Norris, -Essentials of Telemedicine and Telecare, John Wiley & Sons, 1st edition, 2002.
- R3 Richard W. Carlson, -Telemedicine in the ICU, An Issue of Critical Care Clinics, (The Clinics: Internal Medicine), Elsevier, 1st edition, 2015.



Course Objective

The student should be made:

- Understand the design of embedded system for various medical devices.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2					2	2	3	3
CO2	2	2	2	2	2	2					2	2	3	3
CO3	3	3	2	3	2	1					2	2	2	2
CO4	3	3	3	2	2	2					2	2	2	2
CO5	2	2	2	3	2	1					2	2	2	2
CO6	2	2	2	2	2	1					2	2	2	2

UNIT I EMBEDDED DESIGN WITH MICROCONTROLLERS 9

Product specification – hardware / software partitioning- Detailed hardware and software design – integration, product testing- Microprocessor Vs micro controller- Performance tools, bench marking processors- RTOS micro controller -issues in selection of processors.

UNIT II PARTITIONING DECISION 9

Hardware / software duality- Hardware-software portioning, coding for hardware/software development, ASIC revolution- Managing the risk, co-verification, execution environment- Memory organization of controller, memory enhancement- Firmware, speed and code density, system startup.

UNIT III FUNCTIONALITIES FOR SYSTEM DESIGN 9

Timers, watch dog timers- RAM, flash memory, basic toolset, integration of hardware & firmware- Application programming, IDE, target configuration- Host based debugging analyser- Remote debugging, ROM emulators, logic

UNIT IV DESIGN OF PATIENT MONITORING DEVICES 9

Design consideration of patient monitoring systems- Basic block diagram of pulse oximeter, design requirement of device- Circuit implementation of interfacing of oximeter sensors with microcontroller- Software coding and implementation.

UNIT V DESIGNING OF PACEMAKER 9

System description of pacemaker- Design requirement and basic block diagram of pacemaker- Interfacing of pacemaker elements with processors- Software coding of pacemaker and implementation.

Total:45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1:** Attain knowledge on the basic concepts and the building blocks for embedded system
- CO2:** Understand the hardware and software partitioning in embedded systems
- CO3:** Gain knowledge about timers and memory organization of embedded systems



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CO4: Design a pulse oximeter using embedded tool

CO5: Design a pacemaker using embedded tool

CO6: Understand the design of embedded system for various medical devices

TEXTBOOKS:

T1 James K. Peckol, —Embedded system Designl, John Wiley & Sons, 1st edition, 2010

REFERENCEBOOKS:

R1 Geo EliciaWhite,—MakingEmbeddedSystemsI,O'ReillySeries,SPD,1stedition,2011.
Georgi Graschew StefanRakowsky,—TelemedicineTechniquesandApplications,In Tech,
1stedition,2011

R2 G. Baura, "A Biosystems Approach to Industrial Patient Monitoring and
DiagnosticDevicesI, Morgan&Claypool, IEEE,2008.



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B.TECH BIOTECHNOLOGY

U19BTOE001

BASICS OF BIOINFORMATICS

L T P C
3 0 0 3

Course Objectives

To enable the students

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

Course Outcomes

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

- CO1. Use bioinformatics tools with programming skills.
CO2. Apply computational based solutions for biological perspective
CO3. Alignment of nucleotide and protein sequences
CO4. Predict gene and protein structure.
CO5. Construct, interpret and assess the different molecular phylogenetic tree prediction and gene prediction algorithms
CO6. understand the Application of Bioinformatics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				2							1	
2			3		2	3							1	
3			2		3	3							2	
4		3	2			2							2	
5			2		2	3							1	
6	1				1								1	

3 - High, 2 - Medium, 1 - Low

UNIT I

DATABASES

9

Introduction to Bioinformatics-Biological information resources-Genome sequence acquisition and analysis-Retrieval of biological data-Data acquisition, databases, structure and annotation-Data mining and data characteristics.

UNIT II

SEQUENCE ALIGNMENT AND DATABASE SEARCHES

9

Database searches and Sequence Alignment-Pair wise and multiple sequence alignment-Methods of local and global alignment-Dynamic programming, Scoring matrix, PAM, searching sequence databases by sequence similarity-BLAST and FASTA.

UNIT III

PHYLOGENY ANALYSIS

9

Phylogenetics, Molecular Phylogeny and evolutionary analysis-ClustalW, MSA, Dendrogram-Maximum likelihood, Maximum Parsimony, convergent and parallel evolution, Bootstrapping, Jackknifing-Phylograms.

UNIT IV

STRUCTURAL BIOINFORMATICS

9



Signature

Structural bioinformatics, analysis for protein structure, Predicting protein structure and function from Sequence-Homology modeling-Microarray Data analysis- proteomic data analysis-Visualization of molecular structures.

UNIT V

APPLICATIONS OF BIOINFORMATICS

9

Scope of bioinformatics-Bioinformatics in the Pharmaceutical Industry- Structure-Based Rational Drug Design and discovery-Chemi-informatics in Biology.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd., New York.
2. Axevanis, A.D., and Ouellette, B.F.F. (eds) 2006. Bioinformatics A Practical Guide to Analysis of Gene and Proteins. 3rd Edition, John Wiley and Sons, New York.

Course Objectives

To enable the students

- This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications..

Course Outcomes

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

- CO1. Understand in depth of the bioenergy and biofuels.
- CO2. Distinguish various forms of bioenergy and biofuels production
- CO3. Analyse concepts related to and advantages of bioenergy.
- CO4. Develop novel products from biofuels.
- CO5. Understand the environmental sustainability.
- CO6. Understand the yield and efficiency of Biofuels

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3										2	
2	3	2												
3	3	3	3	2	2	2		1	3					2
4	3	1	1			1		1						1
5	3	3	2	1	2			1						1
6	3	3	2	1	2			1						1

UNIT I BASIC CONCEPTS OF BIO-FUELS 9

Biopower, Bioheat, Biofuels, advanced liquid fuels, drop-in fuels, biobased products

UNIT II FEEDSTOCKS 9

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and industrial waste.

UNIT III CONSERVATION TECHNOLOGIES 9

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV BIOMETHANE AND BIOHYDROGEN 9

Biomethanol – Principles, materials and feedstocks, Process technologies and techniques, Advantages and limitations – Biological hydrogen production methods, Fermentative hydrogen production, Hydrogen economy – Advantages and limitations

UNIT V SUSTAINABILITY AND RESILIENCE 9



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Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

TOTAL: 45 HOURS

TEXT BOOKS:

1. Biorenewable Resources – Engineering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biomass for Renewable Energy, Fuels and Chemicals. Donald Klass. Academic press. 1999
3. Introduction to Bioenergy. Vaughn C. Nelson and Kenneth L. Starcher

B.E CIVIL ENGINEERING

U19CEO001

GREEN BUILDINGS

L T P C
3 0 0 3

Course Objectives:

This course aims to provide the students,

- About the importance and necessity of green buildings.
- Asses the boiling based in LEED Rating systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2	1	3		3					2	1	
CO2	2	1	3	2	1	2	3					1	1	
CO3	2	2	2	3	1	1	3					3	1	
CO4			1				3					2	2	
CO5	2		1	2	1		3					3	2	
CO6	3	2	1	2		1	3					1	1	

UNIT I INTRODUCTION 9

Green Building - Need for Green Building - Benefits of Green Buildings - Green Building Materials and Equipment in India - Key Requisites for Constructing a Green Building - Important Sustainable features for Green Building.

UNIT II GREEN BUILDING CONCEPTS AND PRACTISES 9

Indian Green Building Council - Green Building Moment in India - Benefits Experienced in Green Buildings - Launch of Green Building Rating Systems - Residential Sector - Market Transformation. Green Building Opportunities And Benefits: Opportunities of Green Building - Green Building Features, Material and Resources - Water Efficiency - Optimum Energy Efficiency - Typical Energy Saving Approach in Buildings - LEED India Rating System and Energy Efficiency.

UNIT III GREEN BUILDING DESIGN 9

Introduction - Reduction in Energy Demand - Onsite Sources and Sinks - Maximise System Efficiency- Steps to Reduce Energy Demand and Use Onsite Sources and Sinks - Use of Renewable Energy Sources. Eco-friendly captive power generation for factory - Building requirement.

UNIT IV UTILITY OF SOLAR ENERGY IN BUILDINGS 9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings – Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management, Management of Solid Wastes, Management of Sullage Water and Sewage, Urban Environment and Green Buildings, Green Cover and Built Environment.



Course Outcomes:

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

- CO1 : Know about the importance and necessity of green buildings.
- CO2 : Understand the principles of green building certifications (LEED) and low-energy building strategies.
- CO3 : Understand the concepts and principles in Green Building Design..
- CO4 : Suggest materials and technologies to improve energy efficiency of building.
- CO5 : Gain ideas various green composites used in building and sustainable development.
- CO6 : Have an Insight about criteria for rating systems along with established Indian codes an guideline.

Textbooks

- T1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. "Alternative Building Materials and Technologies". New Age International, 2007.
- T2. Low Energy Cooling for Sustainable Buildings. John Wiley and Sons Ltd, 2009.
- T3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Reference Books

- R1. Osman Attmann, "Green Architecture Advanced Technologies and Materials". McGraw Hill, 2010.
- R2. Jerry Yudelson, "Green building Through Integrated Design". McGraw Hill, 2009.
- R3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke.



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Course Objectives:

This course aims to provide the students,

- To Understand the basic concepts of disaster management.
- To acquire knowledge on types and categories of disasters.
- To understand the impacts and challenges posed by disasters.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				1	1	3	1	1			2	1	
CO2	1	2	2	1	1	2	3					1	1	
CO3	1	3	1		2	1	3	1				3	2	
CO4		2	3	1		2	3					1	2	
CO5	3	1	3	3	1	2	3	1				3	1	
CO6	3	2	3	3	1		3					3	1	

UNIT I**INTRODUCTION TO DISASTER**

9

Concepts and definitions - disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation. Global trends in disasters - urban disasters, pandemics, complex emergencies, Climate change. Disaster's classification - natural disasters - manmade disasters - hazard and vulnerability profile of India - mountain and coastal areas, ecological fragility. Dos and Don'ts during various types of Disasters.

UNIT II**DISASTER IMPACTS**

9

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.) - health, psycho, social issues - demographic aspects (gender, age, special needs) - hazard locations - global and national disaster trends - climate change and urban disasters.

UNIT III**DISASTER RISK REDUCTION**

9

Disaster management cycle – its phases : prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures - risk analysis - vulnerability and capacity assessment - early warning systems - Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications) - Roles and responsibilities of government – community - local institutions - NGOs and other stakeholders - Policies and legislation for disaster risk reduction - DRR programmes in India and the activities of National Disaster Management Authority



UNIT IV **DISASTER RISK MANAGEMENT IN INDIA** **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment,

Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V **DISASTERS, ENVIRONMENT AND DEVELOPMENT** **9**

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally

friendly recovery; reconstruction and development methods.

Total: 45 Hours

Course Outcomes:

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

- CO1:** Explain the hierarchical structure in solid waste management and a requirement for an integrated solution.
- CO2:** Define and characterize solid and hazardous wastes from technical and regulatory points of view.
- CO3:** Make route optimization for a solid waste collection and transport system.
- CO4:** Understand the methods of handling, sampling and storage of solid and hazardous waste.
- CO5:** Select the appropriate method for solid waste processing technologies.
- CO6:** Describe disposal methods of solid and hazardous solid waste.

Textbooks:

- T1.** Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
- T2.** Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
- T3.** Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.

Reference Books:

- R1.** Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
- R2.** Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
- R3.** Government of India, National Disaster Management Policy,2009.



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B.E COMPUTER SCIENCE ENGINEERING

U19CSOE001 SOFTWARE ENGINEERING

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COURSE OBJECTIVES

To understand the phases in a software project

- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures•

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1											2
CO2	2	1	1											2
CO3	3	2	2											2
CO4	3	2	2											2
CO5	3	2	2											2
CO6	3	2	2											2

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models
–Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components..



UNIT IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering..

UNIT V PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1** Identify the key activities in managing a software project and recognize different process model
Explain the concepts of requirements engineering and Analysis Modeling.
- CO2**
- CO3** Outline the systematic procedures for software design and deployment
- CO4** Compare various testing and maintenance methods
- CO5** Interpret the project schedule, estimate project cost and effort required.
- CO6** Develop a software using the software engineering principles

TEXT BOOKS:

- T1:** Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition, 2010..
- T2:** Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

- R1:** Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009
- R2:** Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
- R3:** Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
- R4:** Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,2007.



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COURSE OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

PREREQUISITES: NIL

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1											2
CO2	3	2	2											3
CO3	2	1	1											2
CO4	2	1	1											2
CO5	2	1	1											3
CO6	2	1	1											2

UNIT I RELATIONAL DATABASES 10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II DATABASE DESIGN 8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTIONS 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery

UNIT IV TESTING AND MAINTENANCE 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.



UNIT V**PROJECT MANAGEMENT****9**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total: 45 HOURS**COURSE OUTCOMES**

At the end of the course students should be able to

- CO1** Discuss the fundamental concepts of relational database and SQL.
- CO2** Use ER model for Relational model mapping to perform database design effectively
- CO3** Summarize the properties of transactions and concurrency control mechanisms
- CO4** Outline the various storage and optimization techniques
- CO5** Compare and contrast various indexing strategies in different database systems
- CO6** Explain the different advanced databases

TEXT BOOKS:

- T1:** Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011.
- T2:** Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

REFERENCE BOOKS:

- R1:** C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
- R2:** Raghu Ramakrishnan, —Database Management SystemsI, Fourth Edition, McGraw-Hill College Publications, 2015.
- R3:** G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.



B.E ELECTRONICS AND COMMUNICATION ENGINEERING

UI9EEOE001

SOFT COMPUTING

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COURSE OBJECTIVES

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

PREREQUISITES

- Basic concepts of communication theory
- Basics of Computer Networks
- Basics of Biological systems
- Linear Algebra

Course Articulation Matrix : 3- High, 2- Medium, 3- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2							2	1		2
CO2	3	2	2	2							2	1		2
CO3	3	2	2	2							2	1		1
CO4	3	2	2	2							2	1		1
CO5	3	2	2	2							2	1		1
CO6	3	2	2	2							2	1		1

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III FUZZY SYSTEMS 9

– Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHMS 9

BME REGULATION 2019 CURRICULA AND SYLLABI



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Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.

UNIT V

HYBRID SYSTEMS

9

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1:** Apply suitable neural computing techniques for various applications.
- Explain various ANN models
- CO2:**
- CO3:** Apply fuzzy concepts for various applications
- CO4:** Apply genetic algorithms to solve problems
- CO5:** Integrate various soft computing techniques for complex problems.

TEXT BOOKS:

- T1:** N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
- T2:** S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
- T3:** S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCE BOOKS:

- R1:** Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft ComputingI, Prentice-Hall of India, 2002.
- R2:** Kwang H.Lee, —First course on Fuzzy Theory and ApplicationsI, Springer, 2005.
- R3:** George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and ApplicationsI, Prentice Hall, 1996.



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COURSE OBJECTIVES

- To gain knowledge about the various physiological parameters both electrical and non electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques

PREREQUISITES

- Basic Electronics
- Electronic devices

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2							2	1	2	
CO2	3	2	2	2							2	1	2	
CO3	3	2	2	2							2	1	2	
CO4	3	2	2	2							2	1	2	
CO5	3	2	2	2							2	1	2	
CO6	3	2	2	2							2	1	3	

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II NON ELECTRICAL PARAMETER MEASUREMENTS 9

Blood flow meter-Types, Cardiac output measurements-Types, respiratory measurement, blood pressure measurement, temperature and pulse measurement, Blood Cell Counters

UNIT III THERAPEUTIC EQUIPMENTS 9

Cardiac pacemakers - types, Cardiac defibrillators-types, Dialyzers, Heart Lung Machines – Oxygenations, Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy

UNIT IV MEDICAL IMAGING 9

X-Ray machine, computer axial tomography- CT scans, Positron Emission Tomography- PET Scans. MRI and NMR Ultrasonic Imaging systems, Medical Thermograph



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UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION AND APPLICATION IN MEDICINE 9

Bio medical telemetry- remote patient monitoring systems, Telemedicine, Radio pill, Application of cryogenics in medicine, Application of LASERS in medicines. Diagnosis of Cancers and tumors using image processing, diagnosis of dental plague using image processing, diagnosis of various eye problems using image processing

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1:** Know the human body electro- physiological parameters and recording of bio-potentials
- CO2:** Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
- CO3:** Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators
- CO4:** Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods
- CO5:** Know about recent trends in medical instrumentation

TEXT BOOKS:

- T1:** Willie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)
- T2:** Sandpur, R.S., -Handbook of Biomedical Instrumentation, TATA McGraw-Hill, New Delhi, 2003.(UNIT I – V)

REFERENCE BOOKS:

- R1:** Dhake .A.M, " Television and Video Engineering", Mc graw Hill, New Delhi, India, 2006
- R2:** Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015



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B.E ELECTRICAL AND ELECTRONICS ENGINEERING

U19EEOE001 RENEWABLE ENERGY RESOURCES

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COURSE OBJECTIVES

- To get exposure on renewable energy source.
- To know about the solar radiation and its environmental impact to power.
- To learn about the wind energy and its economic aspects.
- To know about geothermal energy with other energy sources.
- To get exposure on distributed generation in storage systems

PREREQUISITES

- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration
- Fundamentals of Battery concepts

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	2		1	3				2		2	
CO2	3		2	2		1	3				2		2	
CO3	3		2	2		1	3				2		2	
CO4	3		2	2		1	3				2		2	
CO5	3		2	2		1	3				2		2	
CO6	3		2	2		1	3				2		3	

UNIT I

INTRODUCTION

9

Energy scenario: National and International – Energy resources and their availability – Conventional power generation plant (Thermal power plant) - Environmental aspects of fossil fuels – Necessity for renewable energy sources – Types of renewable energy source and its limitation.

UNIT II

SOLAR PHOTOVOLTAIC SYSTEM

9

Introduction – Solar radiation and measurements – Basic principle of SPV conversion – Solar energy collectors – Solar energy storage: Solar pond – Types of solar PV cells – PV cell connections – Characteristics of PV module and its parameters - Application of solar energy: Solar pumping and solar cooking.

UNIT III

WIND ENERGY SYSTEM

9

Introduction – Wind energy conversion – Power produced from wind - Relationship between wind speed and power – Components of wind power plant (WPP) – Types of WPP – Selection of site for WPP – Advantages and challenges of WPP.



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UNIT IV**ENERGY FROM OTHER SOURCES****9**

Geothermal energy (GTE): operation of GTE power plants - Types- Advantage of GTE- Tidal energy: Operation of tidal power plant – Ocean Thermal Energy Conversion system: Open and closed cycles - Fuel cell: Construction and working principle- Advantage and applications of Fuel cell.

UNIT V**DISTRIBUTED GENERATION****9**

Concept of DG – Benefits of DG – Types of DG resources – Security issues in integrating DG with power grid - Energy storage elements: Batteries, super-capacitors, flywheels - Captive power plants

Total: 45 HOURS**COURSE OUTCOMES**

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

- CO.1:** Acquire knowledge on power demand scenario of world and the importance of renewable energy sources in meeting the power demand
- CO.2:** Understand the working principle of solar photovoltaic system and its applications
- CO.3:** Outline the various components and performance of wind energy conversion system
- CO.4:** Explain the operation of geothermal and tidal power plants, fuel cell and ocean thermal energy conversion scheme.
- CO.5:** Understand the necessity of distributed generation and energy storage elements.
- CO.6:** Understand about the power generation through renewable energy sources

TEXT BOOKS:

- T1:** Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers, Sixth Edition 2017
- T2:** Khan, B.H, Non-Conventional Energy Resources", Mc. Graw Hill Education Ltd, third reprint 2017.

REFERENCE BOOKS:

- R1:** Rao S. Parulekar,B.B, "Energy Technology –Non Conventional, Renewable and Conventional", KhannaPublishers,1994
- R2:** John Twidell and Tony Weir, "Renewable Energy Resources", Tylor and Francis Publications, Third edition, 2015.
- R3:** Mukund R.Patel, "Wind and Solar Power Systems", CRC Press LLC..



COURSE OBJECTIVES

1. To understand the concepts of control systems-open loop and closed loop control systems.
2. To understand the (mathematical modelling) Transfer function from mechanical, electrical, block diagram and signal flow graph.
3. To learn the concepts of steady state and transient responses from first and second order systems at different inputs and also steady state errors.
4. To learn the stability concepts are Root locus, Bode plot and Polar plot
5. To learn the concept of state space analysis applying on multi-input/output state of the system to find the stability.

PREREQUISITES

- Basic concepts of circuit analysis
- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3			2			2			2	2	
CO2	1	2	3			2			2			2	2	
CO3	1	2	3			2			2			2	2	
CO4	1	2	3			2			2			2	2	
CO5	1	2	3			2			2			2	2	
CO6	1	2	3			2			2			2	3	

UNIT I**INTRODUCTION**

9

Concepts of control systems-open loop and closed loop control systems and their differences-different examples of control systems-classification of control systems, feed-back characteristics, effects of feedback. Mathematical models-differential equations, impulse response and transfer functions.

UNIT II**TRANSFER FUNCTION REPRESENTATION**

9

Block diagram representation of systems considering electrical systems as examples-block diagram algebra-representation by signal flow graph-reduction using mason's gain formula.

UNIT III**TIME RESPONSE ANALYSIS**

9

Standard test signals-time response of first order systems- characteristic equation of feedback control systems, transient response of second order systems-time domain specifications-steady state response-steady state errors and error constants-effects of proportional derivative, proportional integral systems, PID controllers

UNIT IV**STABILITY AND FREQUENCY RESPONSE ANALYSIS**

9

The concept of stability-routh's stability criterion- The root locus concept -construction of root loci-effects of adding poles and zeros to $G(S) H(S)$ on the root loci - Frequency domain specifications - bode diagrams- determination of frequency domain specifications and transfer function from the bode diagram-phase margin and gain margin-stability analysis from bode plots. Polar plots.



UNIT V**STATE SPACE ANALYSIS****9**

Concepts of state, state variables and state model, derivation of state models from block diagrams, diagonalization-solving the time invariant state equations-state transition matrix and it's properties-concepts of controllability and observability.

Total: 45 HOURS**COURSE OUTCOMES**

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

- CO1** Ability to find the Mathematical models-differential equations, impulse response and transfer functions.
- CO2** Ability to find the transfer function from mechanical, electrical, block diagram, signal flow graph and electronic system
- CO3** Describe the concept of steady state and transient response at different inputs
- CO4** Apply the concepts of stability in s-domain and Routh criteria and the concepts of plotting the response of a system on a graph
- CO5** Design and implement any system using state space analysis
- CO6** Ability to implement the real time applications of control systems

TEXT BOOKS:

- T1:** C. Kuo, Automatic Control Systems, 8th edition, John Wiley and sons, India, 2003
- T2:** J. Nagrath, M. Gopal, Control Systems Engineering, 2nd edition, New Age International (P) Limited, New Delhi.

REFERENCE BOOKS:

- R1:** Katsuhiko Ogata, Modern Control Engineering, 3rd edition, Prentice Hall of India Pvt. Ltd., India, 1998
- R2:** Norman S. Nice, Control Systems Engineering, 6th edition, John Wiley, India, 2015
- R3:** N. K. Sinha(1998), Control Systems, 3rd edition, New Age International (P) Limited Publishers, India.



ENGLISH

U19ENOE01

**ENGLISH for COMPETITIVE EXAMS
(Common to ALL)**

L T P C
3 0 0 3

COURSE OBJECTIVES

- To prepare learners to face the challenges of regular/online competitive exams in the English language globally.
- To enable students to prepare for competitive exams of various kinds especially meant for testing ability in the English language.
- To introduce students to the common question types asked in competitive examinations concerning English- grammar, vocabulary, comprehension, and other significant topics.
- To help the students to overcome the fear of English as a compulsory subject in various competitive exams.
- To encourage students to appear and prepare for the competitive exams.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							2	2	2	3		2	2	
CO2								1	2	3		2	2	
CO3						2		2	3	3		2	2	
CO4							3	2	1	3		3	2	
CO5						3	3	3	3	3		3	2	
CO6							2	2	2	3		2	3	

PRE-REQUISITES: Nil

UNIT I

9

Types of Sentences - Sentence correction - Sentence sequence - Word Reordering - Data Interpretation: Tree Diagram, Flow Chart, Table, Line Graph - Discourse Markers - Identifying the exams interested to appear for - Online Course: Udemy, Edx, Future Learn

UNIT II

9

Reading Comprehension: Focus on different levels of Comprehension- Literal, Inferential, Analytical, and Critical reasoning - Identifying keywords and signal words, decoding the building blocks of a passage, understanding the jargon and double distractors - Error Spotting Rules - Identification Common Errors

UNIT III

9

Listening Comprehension: Micro skills and Macro skills of Listening - Idioms and Phrases- Homonyms and Homophones - Collocations- Synonyms and Antonyms: Banking, Indian Constitution, Education, Corporate, and Higher Education - Para jumbles

UNIT IV

9

Speaking: Presentation and Public: Record of videos - Verbal Ability; Sentence Completion, and Verbal analogies - Confirmation of registering for competitive exams.

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COURSE OUTCOME

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

- CO1 Confidently use the English language at an advanced level sharing their points of view with effective conclusions.
- CO2 Construct correct sentences with the advanced vocabulary of the fields like Banking, Indian polity, Education, Corporate, etc.
- CO3 Read accurately using contextual, analytical thinking and logical thinking skills
- CO4 Aware of the opportunities available in the government and private sectors
- CO5 Demonstrate excellent Time Management skills with regard to various competitive exam patterns

TEXT BOOKS

- T1 Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.
- T2 Means, L. Thomas and Elaine Langlois. English and Communication For Colleges. Cengage Learning, USA: 2007.
- T3 The Official Guide to the GRE General Test, Third Edition (TEST PREP) by Educational Testing Service | 16 February 2017
- T4 The Yearly Current Affairs 2022 for Competitive Exams (Upse, State Psc, Ssc, Bank Po/ Clerk, Bba, MBA, Rrb, Nda, Cds, Capf, Crpf), Disha Publication, Genre: General, ISBN: 9789355640888

REFERENCE BOOKS

- R1 Brians, Paul. (2013). Common errors in English usage: Third edition. Wilsonville: Franklin, Beedle & Associates Inc
- R2 Harrison, Louis. (2009). Achieve IELTS grammar and vocabulary: English for international education. London: Cengage Learning EMEA.
- R3 Khashoggi, K., & Astuni, A. (2014). SAT reading comprehension workbook: Advanced practice series. New York: Ilex Publications.
- R4 Prasad, Hari Mohan. (2013). Objective English for competitive exams. New Delhi: Tata McGraw-Hill Education India.
- R5 Seely, John. (2013). Oxford guide to effective writing and speaking: How to communicate clearly. Oxford: Oxford University Press.

WEB RESOURCES

- W1 <https://www.edubull.com/exams/competitive-exams>
- W2 <https://sscstudy.com/>
- W3 <https://examsdaily.in/important-study-materials-pdf>
- W4 <http://www.recruitmenttopper.com/study-material-for-all-competitive-exams/>



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B.TECH FOOD TECHNOLOGY

UI9FTOE001

FOOD SCIENCE AND NUTRITION

L T P C
3 0 0 3

COURSE OBJECTIVES

Explain the basic concepts of food and nutrition. Define the overall classification, function, and source of carbohydrates, lipids and proteins. Discuss the overall aspects of vitamins. Outline the role of health and nutritional importance of micro and macro minerals. Summarize the recent trends in nutrition

- Basic idea on biomolecules
- Knowledge of essential nutrition requirement
- Health benefits and function of nutrition
- Diet based nutrition
- Effect of storage and processing on nutrition

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													2	
2	3	2		3									2	
3	1	3			3			2					1	
4	1				3			2					1	
5													1	
6	1	1		2									1	

UNIT I HUMAN NUTRITION 9+3

Historical perspective of nutrient requirements – Assessment of nutritional status – recommended dietary allowances of macronutrients for all age groups – Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II BIOMOLECULES 9+3

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III VITAMINS 9+3

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

UNIT IV MINERALS 9+3

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

UNIT V RECENT TRENDS IN DIETETICS 9+3

Principles of dietary management in gout, rheumatism, AIDS/HIV – Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods

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and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

Total: 60 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1: Discuss the basics in the area of nutritional assessment in health and disease and to categorize the recommended dietary allowances for different age groups
- CO2: Discuss the classifications, functions and sources of carbohydrates, lipids and proteins
- CO3: Discuss the various attributes of fat- and water-soluble vitamins
- CO4: Report the role, bioavailability, sources and deficiency diseases of macro and micro minerals
- CO5: Recognize the diets and concepts of foods suggested for nutritional, chronic and acute disorders
- CO6: Classify and to analyse the different techniques of qualitative and quantitative analysis

TEXT BOOKS:

- T1: Jordan M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition. 2013.
- T2: Shubhangi A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition. 2016.
- T3: Kirilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017.

REFERENCE BOOKS:

- R1: Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell. 2003.
- R2: Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018.



UI9FTOE002

FOOD PRESERVATION TECHNIQUES

L T P C
3 0 0 3

Course Objectives

- To introduce the students to the area of Food Processing and preservation.
- To have an effective understanding of food processing and technology subjects.
- To enable students to appreciate the importance of food processing with respect to the large-scale production.
- To impart knowledge on processing of food waste

Course Outcomes

- At the end of the course, learners will be able to:
- C01: Describe the fundamentals of food processing and preservation
- C02: Familiar with the functional properties of Carbohydrates, fats, lipids, proteins in food
- C03: Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness
- C04: Analyze the uses of enzymes, modified proteins and develop novel products, explain, analyze and evaluate scenarios related to various unit operations in food processing and preservation
- C05: Identify spoilage and deterioration mechanism in food and methods to control deterioration and spoilage
- C06: Demonstrate packing methods, materials and factors affecting food packing

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3											
2	3													
3	2		3										3	
4	3	3	2								3			
5		3	2								3			
6	3	2	2	2	2	1	2							

3 - High, 2 - Medium, 1 - Low

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 12

Source of food - significance for processing and preservation of foods – Different food groups-, food pyramids, classification and functions, cooking of foods – methods and cooking media, advantages of processing of foods, changes of nutritional components in cooking, effects of processing of foods on anti-nutritional components.

UNIT II FOOD COMPONENTS 12

Classification, Structure, nutritive value, processing outlines of major Cereals and millets-Pulses-fruits and vegetables, fats, oilseeds and nuts. Major and minor nutrients, sugar and related products, spices and aromatics, beverages and appetizers, organic foods

UNIT III PROCESSING OF ANIMAL FOODS 12

Meat, Poultry and Fish-Structure, composition, nutritive value and processing outline. Processing of milk and milk products, egg processing and storage, need and nutritional benefits of animal products, value added products

UNIT IV INTRODUCTION TO FOOD PROCESSING AND PRESERVATION 12

Food spoilage, fermentation, methods of preservation - High temperature and Low temperature Preservation, traditional methods of food processing and preservation, radiation processing, microwave, non-thermal techniques. Role of enzymes and additives in food preservation

UNIT V FOOD PACKAGING AND QUALITY 12

Food packaging – importance, types and functions, packaging materials – synthetic and natural, Impact of packaging materials on food quality, shelf-life of foods, bottling and canning, nutritional labelling, labelling of vegan and animal based products



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TOTAL: 60 PERIODS

TEXT BOOKS

Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.

REFERENCES

Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005

WEBSITES:

1. <https://www.heartfoundation.org.nz/educators/edu-resources/food-tech>
2. <https://www.stemcrew.org/guides/subjects/food-technology-teaching-resources/>

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B.TECH INFORMATION TECHNOLOGY

L T P C

U19ITOE001

**UI AND UX
DESIGN**

2 0 2 3

COURSE OBJECTIVES

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype.

CO ^s	PROGRAMME OUTCOMES (POs)											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		2				3		2	2		
CO2	3	2	3		2				3		2	2		
CO3	3	2	3		2				3		2	2		
CO4	3	2	3		2				3		2	2		
CO5	3	2	3		2				3		2	2		
CO6	3	2	3		2				3		2	2		

UNIT I: FOUNDATIONS OF DESIGN 9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II: FOUNDATIONS OF UI DESIGN 9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides 126

UNIT III: FOUNDATIONS OF UX DESIGN 9

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Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT IV: WIREFRAMING, PROTOTYPING AND TESTING 9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V: RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

Total: 45 HOURS

TEXT BOOKS

1. Joel Marsh, "UX for Beginners", O'Reilly , 2022
2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021 127

3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer IE, 2004. **REFERENCE BOOKS**

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018
3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4. <https://www.nngroup.com/articles/>
5. [https://www.interaction-design.org/literature.](https://www.interaction-design.org/literature)

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Understand the principles of UI and UX design, including user-centered design, information architecture, visual hierarchy, and usability testing.

CO2:Build UI for user Applications

CO3:Evaluate UX design of any product or application

CO4:Demonstrate UX Skills in product development

CO5:Implement Sketching principles

CO6:Create Wireframe and Prototype



COURSE OBJECTIVES

- To enrich student learning in multimedia systems.
- To train the students to acquire knowledge in multimedia related technologies.
- To acquire knowledge about multimedia techniques to enhance quality of service.
- To acquire knowledge on multimedia architecture.
- To learn about the multimedia elements in a comprehensive way.

COs	PROGRAMME OUTCOMES (POs)											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		3	2	2			3	2			1
CO2	3	2	3		3	2	2			3	2			1
CO3	3	2	3		3	2	2			3	2			2
CO4	3	2	3		3	2	2			3	2			2
CO5	3	2	3		3	2	2			3	2			2
CO6	3	2	3		3	2	2			3	2			2

UNIT I: INTRODUCTION TO MULTIMEDIA ELEMENTS 9

Multimedia – Medium – Properties of a Multimedia System – Traditional Data Stream Characteristics – Data Stream Characteristics of Continuous Media – Basic Sound Concepts – Speech – Images and Graphics – Computer Image Processing – Video and Animation – Computer Based Animation.

UNIT II: MULTIMEDIA COMPRESSION 9

Storage Space – Coding Requirements – Hybrid Coding – JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode – H.261 – MPEG: Video Encoding, Audio Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21 – DVI – Audio Encoding

UNIT III: MULTIMEDIA ARCHITECTURES 9

User Interfaces – OS multimedia support – Multimedia Extensions – Hardware Support – Distributed multimedia applications – Real time protocols – Play back Architectures – Synchronization – Document and document architecture – Hypermedia concepts – Hypermedia design – Digital copyrights – Digital Library – Multimedia Archives.

UNIT IV: MULTIMEDIA OPERATING SYSTEM AND DATABASES 9



Real Time – Resource Management – Process Management – File systems – Interprocess communication and synchronization – Memory management – Device Management – Characteristics of MDBMS – Data Analysis – Data structures – Operations on data – Integration in a database model.

UNIT V: MULTIMEDIA COMMUNICATION & APPLICATIONS 9

Tele Services – Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services – Media Consumption – Media Entertainment – Virtual Reality – Interactive Audio – Interactive Video – Games.

Total: 45 HOURS

TEXT BOOKS

1. Ralf Steinmetz, Klara Nahrstedt, "Multimedia computing, communications, and applications", Pearson India, 2009.
2. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw Hill Education, 2017.
3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer IE, 2004.

REFERENCE BOOKS

1. Tay Vaughan, "Multimedia: Making it Work", McGraw – Hill Education, Ninth Edition, 2014.
2. Mark S Drew, Zee Nian Li, "Fundamentals of multimedia", Prentice Hall, 2006.
3. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. "Baker Digital Compression for Multimedia: Principles and Standards", Elsevier, 2006.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Handle the multimedia elements effectively

CO2: Encode and decode the multimedia elements.

CO3: Understand the underlying multimedia computing architectures used for media development.

CO4: Develop effective strategies to deliver Quality-of-Experience in multimedia applications.

CO5: Design and implement algorithms and techniques related to multimedia objects.

CO6: Design and develop multimedia applications in various domains.



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Mechanical Properties: Introduction, Grain Size Effect, Creep, Hardness, Fracture Strength, Strengthening and Toughening Mechanisms, Crack Healing (Annealing Treatment). [From Advanced nanomaterials by Hofman, Powder Technology Laboratory, IMX, EPFL, Version 1 Sept 2009].

Electrical and Optical properties: Electrical conduction and tunnelling conduction in nanoparticles, electronic conduction with nanoparticles (AC Conductivity & DC Conductivity).

Optical properties: Transmission, Absorption, Reflection in nanoparticles, optical constants (Absorption coefficient, extinction coefficient and Refractive index).

UNIT IV CHARACTERIZATION TOOLS 9

XRD (X-Ray diffraction), SAXS (Small Angle X-ray Emission Spectroscopy), SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy), STM (Scanning Tunnelling Microscopy), AFM (Atomic Force Microscopy).

UNIT V APPLICATIONS OF NANOTECHNOLOGY 9

Electrical and electronic applications: MEMS (Micro Electro Mechanical Systems), NEMS (Nano Electro Mechanical Systems), Nanosensors, nanolithography.

Nanotechnology for Renewable Energy: Hydrogen energy, fuel cell technology, wind and solar energy. Nanotechnology for information technology and Data Storage applications.

Total:45 Hours

COURSE OUTCOME

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

- | | |
|------------|---|
| CO1 | Apply the basic concepts of nanotechnology and gain basic knowledge on various synthesis and characterization techniques involved in Nanotechnology |
| CO2 | Understand the general types and different classes of Nanomaterials |
| CO3 | Apply the knowledge on different properties of Nanomaterials and selection of material for the specific purpose of application. |
| CO4 | Understand and apply the knowledge of different characterization tools and characterization of Nanomaterials |
| CO5 | Apply the basic knowledge about the wide applications of nanotechnology in various technological fields. |
| CO6 | Understand about different energy technology |

TEXT BOOKS

- | | |
|-----------|--|
| T1 | Köhler, Michael, and Wolfgang Fritzsche. Nanotechnology - An Introduction to Nanostructuring Techniques 2nd ed. Wiley. |
| T2 | T. Pradeep, Nano: The Essentials – Understanding Nano Science and Nano Technology, McGraw-Hill |
| T3 | A. K. Bandyopadhyay, Nano Materials, New Age International Publishers. |
| T4 | M. H. Fulekar, Nanotechnology - Importance and applications. I.K. International publishing house pvt. ltd |

REFERENCE BOOKS

- | | |
|-----------|--|
| R1 | B.S. Murty, P. Shankar, Baldev Raj, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin Heidelberg |
| R2 | B. Bhushan, Springer Handbook of Nano Technology |



B.E MECHANICAL ENGINEERING

19MEOE001	ENGINEERING DRAWING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To have the knowledge of interpretation of dimensions of different quadrant projections.
- To understand the basic principles of engineering drawing.
- To have the knowledge of generating the pictorial views

PRE-REQUISITES

Nil

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3									3	
CO2	3	2		3				2					3	
CO3	3	3		3									3	
CO4	3	2		3				2					2	
CO5	3	2		3									3	

THEORY COMPONENT CONTENTS

UNIT I INTRODUCTION TO ENGINEERING DRAWING 12

Principles of engineering graphics and their significance – drawing instruments and their use – conventions in drawing – lettering – BIS conventions. Dimensioning rules, geometrical construction CURVES USED IN ENGINEERING PRACTICE AND THEIR CONSTRUCTIONS: Conic Sections, Special Curves-Cycloids, Epicycloids, and Hypocycloids.

UNIT II ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY 12

Principles of orthographic projections – conventions – first and third angle projections. Projections of points and lines inclined to both the planes.

UNIT III PROJECTIONS OF PLANES AND SOLIDS 12

Projections of regular planes, inclined to both planes. Projections of regular solids inclined to both planes.

UNIT IV DEVELOPMENT OF SURFACES 12

Development of surfaces of right, regular solids – development of prisms, cylinders, pyramids, cones and their parts.

UNIT V ISOMETRIC PROJECTIONS 12



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Principles of Isometric Projections-Isometric Scale- Isometric Views-Conventions-Plane Figures, Simple and Compound Solids.**TRANSFORMATION OF PROJECTIONS:** Conversion of isometric Views to Orthographic Views.Conversion of orthographic views to isometric projections vice-versa

Total:60 Hours

COURSE OUTCOMES

On completion of this course students will be able to

- CO1 : Prepare and understand drawings.
- CO2 : Identify various D curves used in Engineering Drawing and their applications.
- CO3 : Use the principles of orthographic projections.
- CO4 : By studying about projections of solids students will be able to visualize three dimensional objects and that will enable them to design new products.
- CO5 : Design and fabricate surfaces of different shapes.

TEXT BOOKS

- T1. BasantAgarwal, "Engineering Drawing", TMH.
- T2. Jolhe, Dhananjay, "Engineering Drawing: With an Introduction to CAD", Tata McGrawHill, India. 2006.

REFERENCE BOOKS

- R 1. N. D. Bhat, "Engineering Drawing" Charotar Publications, New Delhi., 2006.
- R2. Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishers, 2007



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U19MEOE002

**MODERN MANUFACTURING
TECHNIQUES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the various advancements in casting processes
- To learn about the different types of welding techniques.
- To understand the principles and process of forming.
- To understand the significance of different advancements such as CAE in manufacturing.
- To learn about the mechanics of high speed machining.

PRE-REQUISITES

1. Fundamentals of manufacturing processes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2		2		2		2		2			2	
CO2				1									1	
CO3		1		2									2	
CO4	1	1		1		1				1			1	
CO5	2			1		1		2					1	

THEORY COMPONENT CONTENTS**UNIT I ADVANCED CASTING PROCESSES 9**

Expendable-Mold - shell mould casting, Vacuum Mould casting, investment casting, plaster-mold and ceramic-mold casting, Permanent-Mold casting processes - squeeze casting and semisolid metal casting, centrifugal casting, uses of Rapid Prototyping to produce pattern, process selection - dimensional tolerances for various casting processes and metals.

UNIT II ADVANCED WELDING PROCESSES 9

Electron beam welding, laser beam welding, Solid-State welding - diffusion welding, friction welding, ultrasonic welding, physics of welding, design considerations in welding, NDT methods for testing.

UNIT III ADVANCED FORMING PROCESSES 9

Material behavior in metal forming, temperature in metal forming, strain rate sensitivity, friction and lubrication in metal forming, bulk deformation processes, sheet metalworking, HERF, hydro forming, explosive forming, magnetic forming process

UNIT IV APPLICATION OF CAE IN MANUFACTURING 9

Need for CAE in manufacturing, simulation of molten metal flow using CAE Techniques, solidification process in casting, inspections of casting. Thermal analysis of Heat-Affected Zone (HAZ), analysis of forging process using CAE, CL data generation for machining process.

UNIT V HIGH-SPEED MACHINING 9

BME REGULATION 2019 CURRICULA AND SYLLABI



High-Speed machining centers, high-speed spindles, spindle speed, feed rate, cutting velocity, surface finish, selection of process parameters, ultra-high-speed machining centers, hard machining.

Total: 45 Hours

COURSE OUTCOMES

At the end of the course students should have the

- CO1 : Use appropriate casting technique to develop a given component
- CO2 : Make the right choice of welding technique as per the required application
- CO3 : Understand about the different significant factors in forming
- CO4 : Formulate real time problems with the help of computer simulation tools
- CO5 : Implementing the probable capabilities of artificial intelligence to develop end user products such as robots.

TEXT BOOKS

- T1. Mikell P Grover "Principles of Modern Manufacturing (SI Version)" John Wiley & Sons, 2014.
- T2. Paul DeGarmo E, Black J T and Ronald A Kohjer, "Materials and Processes in Manufacturing, John Wiley India, 2011.

REFERENCE BOOKS

- R 1. Philip F Ostwald and Jairo Munoz, "Manufacturing Processes and Systems" John Wiley India, New Delhi, 2013.
- R2. Kaushish J P, "Manufacturing Processes", Prentice Hall India, 2013.
- R3. Sanjay K Mazumdar, "Composite Manufacturing: Materials, Product and Process Engineering", CRC Press, 2010.



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UI9ENOE01

ENGLISH for COMPETITIVE EXAMS
(Common to ALL)

L T P C
3 0 0 3

COURSE OBJECTIVES

- To prepare learners to face the challenges of regular/online competitive exams in the English language globally.
- To enable students to prepare for competitive exams of various kinds especially meant for testing ability in the English language.
- To introduce students to the common question types asked in competitive examinations concerning English- grammar, vocabulary, comprehension, and other significant topics.
- To help the students to overcome the fear of English as a compulsory subject in various competitive exams.
- To encourage students to appear and prepare for the competitive exams.

PRE-REQUISITES: Nil

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

UNIT I

9

Types of Sentences - Sentence correction - Sentence sequence - Word Reordering - Data Interpretation: Tree Diagram, Flow Chart, Table, Line Graph - Discourse Markers - Identifying the exams interested to appear for - Online Course: Udemy, Edx, Future Learn

UNIT II

9

Reading Comprehension: Focus on different levels of Comprehension- Literal, Inferential, Analytical, and Critical reasoning - Identifying keywords and signal words, decoding the building blocks of a passage, understanding the jargon and double distractors - Error Spotting Rules - Identification of Common Errors

UNIT III

9

Listening Comprehension: Micro skills and Macro skills of Listening - Idioms and Phrases- Homonyms and Homophones - Collocations- Synonyms and Antonyms: Banking, Indian Constitution, Education, Corporate, and Higher Education - Para jumbles

UNIT IV

9

Speaking: Presentation and Public: Record of videos - Verbal Ability; Sentence Completion, and Verbal analogies - Confirmation of registering for competitive exams.

UNIT V

9

Speech Project - Time Management - Stress Management - Standard Assessment: 5 Mock Tests

Total: 45 HOURS



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COURSE OUTCOME

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

- CO1 Confidently use the English language at an advanced level sharing their points of view with effective conclusions.
- CO2 Construct correct sentences with the advanced vocabulary of the fields like Banking, Indian polity, Education, Corporate, etc.
- CO3 Read accurately using contextual, analytical thinking and logical thinking skills
- CO4 Aware of the opportunities available in the government and private sectors
- CO5 Demonstrate excellent Time Management skills with regard to various competitive exam patterns

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OPEN ELECTIVE II

B.TECH AGRICULTURAL ENGINEERING

U19AEOE003

Introduction to Bio-Energy

L T P C
3 0 0 3

COURSE OBJECTIVES

To introduce to the students the concepts of bio energy resources

- To expose the students to types of energy resources
- To enhance knowledge on estimation of bio energy plants.
- To expose the students to bio fuel production.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				2	2						1	
CO2	3	2				2	2						1	
CO3	3	2				2	2						1	
CO4	3	2				2	2						1	
CO5	3	2				2	2						1	
CO6	3	2				2	2						1	

UNIT I BIO RESOURCE - AN INTRODUCTION 9

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

UNIT II BIO ENERGY 9

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.

UNIT III BIO REACTORS AND FERMENTORS 9

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Down stream processing-Recovery and purification of products.

UNIT IV ALCOHOL PRODUCTION 9

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics- enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers

BME REGULATION 2019 CURRICULA AND SYLLABI



UNIT V**ENERGY AND ENVIRONMENT****9**

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – Bioenergy policy.

Total: 45 HOURS**COURSE OUTCOMES**

At the end of the course students should be able to

- CO1** Understanding the importance of bio resources .
Ability to classify the bio energy and characteristics of bio energy.
- CO2**
- CO3** Knowledge in bio reactors and fermentors.
- CO4** Ability to gain knowledge in Alcohol production process
- CO5** Understanding the importance of Energy and Environment
- CO6** Knowledge in capturing and applying bioenergy on replacement of fossil fuels.

TEXT BOOKS:

- T1:** Rai G.D, Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
- T2:** Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE BOOKS:

- R1:** Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986
- R2:** Khandelwal K.C. and Mahdi, S.S. 1986. Biogas Technology. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.
- R3:** Srivastava, P.K., Shukla, B.D. and Ojha, T.P. 1993. Technology and application of biogas. Jain Brothers, New Delhi.
- R4:** Mathur, A.N. and Rathore, N.S. 1993. Biogas production Management and Utilisation. Himanshu Publication. New Delhi



COURSE OBJECTIVES

- To introduce the overview of robotic systems and their dynamics
- To impart knowledge on system stability
- To acquire knowledge on joint space and task space control schemes
- To understand the concept of nonlinear control and observer schemes

PREREQUISITES: NIL

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												1	
CO2	3												1	
CO3	3	2	2	2									1	
CO4	3	2	2	2									1	
CO5	3	3	2	2									1	
CO6	2	3	2	1									1	

UNIT I INTRODUCTION AND OVERVIEW OF ROBOTIC SYSTEMS AND THEIR DYNAMICS 10

Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes.

UNIT II SYSTEM STABILITY AND TYPES OF STABILITY 8

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis.

UNIT III JOINT SPACE AND TASK SPACE CONTROL SCHEMES 10

Position control, velocity control, trajectory control and force control.

UNIT IV NONLINEAR CONTROL SCHEMES 9

Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control

UNIT V NONLINEAR OBSERVER SCHEMES 8

Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA.



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Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1** Understand basic concept of robotic systems and their dynamics.
- CO2** Analyze system stability and types of stability
- CO3** Know about joint space and task space control schemes
- CO4** Understand the concept of nonlinear control and observer schemes
- CO5** Gain knowledge on farm management and financial analysis
- CO6** Familiarize with budgeting and cost estimation for farm layout

TEXT BOOKS:

- T1:** R Kelly, D. Santibanez, LP Victor and Julio Antonio, —Control of Robot Manipulators in Joint Space, Springer, 2005.
- T2:** A Sabanovic and K Ohnishi, —Motion Control Systems, John Wiley & Sons (Asia), 2011

REFERENCE BOOKS:

- R1:** R M Murray, Z. Li and SS Sastry, —A Mathematical Introduction to Robotic Manipulation, CRC Press, 1994.
- R2:** J J Craig, —Introduction to Robotics: Mechanics and Control, Prentice Hall, 4th Ed, 2018.



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B.E BIOMEDICAL ENGINEERING

U19BMOE003

HOSPITAL MANAGEMENT SYSTEM

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3 0 0 3

Course Objective

The student should be made:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3		1	2				1		2	2
CO2	2	3	3	3		1	3				1		3	2
CO3	2	3	3	3		1	3				1		3	3
CO4	3	2	3	3		1	2				1		2	3
CO5	2	2	3	3		1	2				1		2	2
CO6	2	2	3	3		1	2				1		2	2

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – 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, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS 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 - The buyer decision process - Model of business buyer behavior – Major types of buying situations - 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.

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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 – Environment Management Systems. NABA, JCI, NABL. 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 HOURS**Course Outcomes**

At the end of the course, learners will be able to:

- CO1: Explain the principles of Hospital administration.
- CO2: Identify the importance of Human resource management.
- CO3: List various marketing research techniques.
- CO4: Identify Information management systems and its uses.
- CO5: Understand safety procedures followed in hospitals
- CO6: Analyze the quality and safety aspects in hospital.

TEXT BOOKS

1. R.C.Goyal, —Hospital Administration and Human Resource Management, PHI – Fourth Edition, 2006.
2. G.D.Kunders, —Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, —The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, —Handbook of Health Care Human Resources Management, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman —Health Sector Reform in Developing CountriesI - Harvard University Press, 1995.
4. William A. Reinke —Health Planning For Effective ManagementI - Oxford University Press. 1988
5. Blane, David, Brunner, —Health and SOCIAL Organization: Towards a Health Policy for the 21st CenturyI, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, —Health Care ManagementI, 6th Edition Cengage Learning, 2011.



Course Objective

The student should be made:

To impart knowledge of the principle of operation and design of sensory equipment's.

To render a broad and modern account of neurological, muscular, cardiological and respiratory instruments.

To introduce idea about instrumentation in patient care and diagnosis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3						2	2	2	3	3
CO2	3	3	3	3						2	3	2	3	3
CO3	3	3	3	3						2	2	3	3	3
CO4	3	3	3	3						2	2	2	3	3
CO5	3	3	3	3						2	3	2	3	3
CO6	3	3	3	3						2	2	2	3	3

UNIT I RECORDING OF BIOSIGNALS 9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, Lead configuration, 12 lead ECG machine circuit, common mode and interference reduction circuits, Vector cardiograph EEG – 10-20 electrode system. EMG– Recording, Electro encephalogram, Magneto encephalogram, EOG & ERG: origin, measurement of EOG, electroretinogram

UNIT II SENSORY INSTRUMENTATION 9

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Hearing and speech aids: conductive and nervous, hearing aids- Types, constructional and functional characteristics. Cochlear implants-Need, constructional details, speech trainer.

UNIT III CARDIAC EQUIPMENTS 9

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT IV RESPIRATORY MEASUREMENT 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**ADVANCED DEVICES**

9

Cardiac pacemakers and modern stimulators, Hemodialysis ventilators, incubators, drug delivery devices, surgical instruments, Therapeutic application of laser, Neonatal Monitoring.

Total:45 HOURS**COURSE OUTCOMES**

At the end of the course students should be able to

- CO1:** Demonstrate the principle of operation and design of sensory equipments
- CO2:** Determine the basic parameters of the equipment used in patient diagnosis
- CO3:** Analyze the broad and modern account of neurological equipments.
- CO4:** Illustrate the principle and working of muscular and respiratory instruments
- CO5:** Impart knowledge of the principle of operation and design of sensory equipment's
- CO6:** Understand a broad and modern account of neurological, muscular, cardiological and respiratory instruments

TEXTBOOKS:

- T1** Siamak Najarian, Javad Dargahi, Ali AboueiMehrizi, —Artificial Tactile Sensing in Biomedical EngineeringI, McGraw Hill publication, 2009
- T2** Martin Grunwald, —Human Haptic PerceptionI, Birkhaeuser Verlag AG, Boston Basel Berlin publication, 2008

REFERENCE BOOKS:

- R1** Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha,—Haptics Technologies: Bringing touch to multimedial, Springer, 2011
- R2** Myer Kutz.,—Biomedical Engineering and Design Handbook I Vol2, McGraw Hill



General description of chromatography – Band broadening and optimization of column performance-
Liquid chromatography – Partition chromatography – Adsorption chromatography
– Ion exchange chromatography -size exclusion chromatography- Affinity chromatography
principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion
selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry -
Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe
microscopes – AFM and STM.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanký, R. Crouch Instrumental Methods of Analysis. Cengage Learning, 2007
2. Willard, Hobart, et al., Instrumental Methods of Analysis. VIIIth Edition, CBS, 1986
3. Haven, Mary C., et al., Laboratory Instrumentation .IVth Edition, John Wiley, 1995.



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Course Objectives

- To emphasize on the importance of waste management in the industries

Course Outcomes

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

- CO1. This course will make the students to design biological treatment units
- CO2. To undertake projects on biological wastewater treatment
- CO3. To design the treatment plants with fundamental understanding
- CO4. Be familiar with sampling of wastes.
- CO5. The students will undertake projects related to waste management.
- CO6. Understand various case studies related to waste management

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3										2	
2	3	2												
3	3	3	3	2	2	2		1	3					2
4	3	1	1			1		1						1
5	3	3	2	1	2			1						1
6	3	3	2	1	2			1						1

UNIT I INTRODUCTION TO WASTE MANAGEMENT 9

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II CLEANER PRODUCTION 9

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

UNIT III POLLUTION FROM MAJOR INDUSTRIES 9

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

UNIT IV REACTORS USED IN WASTE WATER TREATMENT 9

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Theory: Modeling of Ideal Attached Growth Reactors, Bio-film Modeling Aerobic Growth of Biomass in Packed Towers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

UNIT V

CASE STUDIES

9

Industrial manufacturing process description, Wastewater characteristics, Pollution Prevention Options and Treatment Flow sheets for selected Industries – Tanneries- Textiles- Pulp and Paper Metal finishing – Sugar and Distilleries.

TOTAL: 45 HOURS

TEXT BOOKS

1. Bhatia, Handbook of Industrial Pollution and Control, Volume I and II, CBS Publishers, New Delhi, 2003
2. Mahajan, S.P. Pollution Control in Process Industries, Tata McGraw Hill Publishing Co., New Delhi, 1991.



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B.E CIVIL ENGINEERING

UI9CEOE003

REMOTE SENSING AND GIS

L T P C
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Course Objectives:

This course aims to provide the students,

- Understanding about the basic concepts of remote sensing and analyse satellite imagery and extract the required units.
- Usage of thematic maps for various application.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	1	2	3	3		1			3	2	
2	3	2	2		3	1	3					2	2	
3	2	3	2			3	3					2	2	
4	2	2				3	3		1			2	2	
5	1	1			3	3	3		1			1	2	
6	2	2			3	3	3		-			2	2	

UNIT I REMOTE SENSING 9

Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration

and Image and False colour composite, elements of visual interpretation techniques.

UNIT II REMOTE SENSING PLATFORMS AND SENSORS 9

Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms – IRS, sensors, sensor resolutions, Basics of digital image processing - introduction to digital data, systematic errors and non-systematic errors, Image

enhancements, image filtering.

UNIT III GEOGRAPHIC INFORMATION SYSTEM 9

Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute Data

- Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.

UNIT IV DATA MODELS 9



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Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model,

Types of Raster Data, Raster Data Structure, Data conversion.

UNIT V INTEGRATED APPLICATIONS OF REMOTE SENSING AND GIS 9

Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and Its Applications.

Total: 45 Hours

Course Outcomes:

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

- CO1:** Understand the principles of aerial and satellite remote sensing. Able to comprehend the energy interactions with earth surface features.
- CO2:** Understand the basic concepts of remote sensing and know about different types of satellite and sensors.
- CO3:** Illustrate spatial and non-spatial data features in GIS and understand the map projections and coordinates systems
- CO4:** Collect data and delineate various elements from the satellite imagery using their spectral signature.
- CO5:** Apply knowledge of GIS and understand the integration of Remote Sensing and GIS.

Textbooks:

- T1.** Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008.
- T2.** Narayan Panigrahi, "Geographical Information Science", and ISBN 10: 8173716285 / ISBN 13: 9788173716287, University Press 2008.
- T3.** Basudeb Bhatta, "Remote sensing and GIS", Oxford University Press 2011

Reference Books:

- R1.** Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
- R2.** Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geographical Information system", Oxford Publications 2004.
- R3.** S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005.



U19CEOE004

**AIR POLLUTION AND CONTROL
ENGINEERING**

L T P C
3 0 0 3

Course Objectives:

This course aims to provide the students,

- Knowledge on the principle and design of control of Indoor/ particulate / gaseous air pollutant and its emerging trends.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				1								2	
2	2	1			3								2	
3	3			1	2								2	
4	2		1	1	2								2	
5	2	1	2	1									2	
6	2				1								2	

UNIT I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards

UNIT II METEOROLOGY 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns - Atmospheric Diffusion Theories – Dispersion models, Plume rise

UNIT III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

UNIT V INDOOR AIR QUALITY MANAGEMENT 9

Sources, types and control of indoor air pollutants, sick building syndrome and building related illness Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

BME REGULATION 2019 CURRICULA AND SYLLABI



Total: 45 Hours

Course Outcomes:

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

- CO1:** Understanding of the nature and characteristics of air pollutants and basic concepts of air quality management.
- CO2:** Understand the type and nature of air pollutants, the behaviour of plumes and relevant meteorological determinants influencing the dispersion of air pollutants.
- CO3:** Ability to identify, formulate and solve air and noise pollution problems.
- CO4:** Ability to design stacks and particulate air pollution control devices to meet applicable standards.
- CO5:** Ability to select control equipment's.
- CO6:** Ability to ensure quality, control and preventive measures

Textbooks:

- T1.** Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science media LLC,2004.
- T2.** Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017. **T3.** Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.
- T1.** Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science media LLC,2004.

Reference Books:

- R1.** David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
- R2.** Arthur C. Stern, "Air Pollution (Vol. I – Vol. VIII)", Academic Press, 2006.
- R3.** Wayne T. Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.



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B.E COMPUTER SCIENCE ENGINEERING

U19CSOE003

DATA STRUCTURES AND ALGORITHMS

L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 3- Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													1
CO2	3													2
CO3	3	2	2	2										2
CO4	3	2	2	2										2
CO5	3	3	2	2										1
CO6	2	3	2	1										1

UNIT I ALGORITHM ANALYSIS, LIST ADT 11

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

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 SEARCHING AND SORTING ALGORITHMS 8

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT IV TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C



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UNIT V

GRAPHS

8

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method - Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1 Define data structures like array, stack, queues and linked list.
- CO2 Explain insertion, deletion and traversing operations on data structures.
- CO3 Identify the asymptotic notations to find the complexity of an algorithm.
- CO4 Compare various searching and sorting techniques.
- CO5 Choose appropriate data structure while designing the algorithms.
- CO6 Design advance data structures using non linear data structures.

TEXT BOOKS:

- T1: Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 1997..
- T2: Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 1988.

REFERENCE BOOKS:

- R1: Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983
- R2: S.Sridhar, "Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014
- R3: Byron Gottfried, Jitender Chhabra, "Programming with C" (Schaum's Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010
- R4: Yashvant Kanetkar, "Data Structures Through C", BPB publications, II edition, 2003



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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

UI9ECOE003 CONSUMER ELECTRONICS

L T P C
3 0 0 3

COURSE OBJECTIVES

- .Understand troubleshooting in loudspeakers and Microphones
- Gain knowledge on television signals and components
- Gain knowledge on various types of audio recording and playback techniques
- Understand communication systems
- Understand principle of working of home appliances

PREREQUISITES

- Basic Electronics
- Electronic devices

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2							2	1	2	
CO2	3	2	2	2							2	1	2	
CO3	3	2	2	2							2	1	2	
CO4	3	2	2	2							2	1	2	
CO5	3	2	2	2							2	1	2	
CO6	3	2	2	2							2	1	3	

UNIT I LOUDSPEAKERS AND MICROPHONES 9

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones

UNIT II TELEVISION STANDARDS AND SYSTEMS 9

Components of a TV system – interlacing – composite video signal. Colour TV – Luminance and Chrominance signal; Monochrome and Colour Picture Tubes - Colour TV systems – NTSC, PAL,SECAM - Components of a Remote Control.

UNIT III OPTICAL RECORDING AND REPRODUCTION 9

Audio Disc – Processing of the Audio signal – read out from the Disc –Reconstruction of the audio signal – Video Disc – Video disc formats- recording systems – Playback Systems.

UNIT IV TELECOMMUNICATION SYSTEMS 9

Telephone services - telephone networks – switching system principles –PAPX switching – Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems



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UNIT V**HOME APPLIANCES****9**

Basic principle and block diagram of microwave oven; washing machine hardware and software; components of air conditioning and refrigeration systems

Total: 45 HOURS**COURSE OUTCOMES**

At the end of the course students should be able to

- CO1** Troubleshoot different types of microphones and speakers
Maintain audio systems
- CO2:**
- CO3:** Analyse composite video signal used in TV transmission
- CO4:** Troubleshoot TV Receivers
- CO5:** Maintain various home appliances

TEXT BOOKS:

- T1:** S.P.Bali, "Consumer Electronics", Pearson Education, 2005.
- T2:** Gupta. R.G, " Audio Video Systems principles maintenance and trouble shooting, Mc graw Hill, New Delhi, India, 2010

REFERENCE BOOKS:

- R1:** Dhake .A.M, " Television and Video Engineering", Mc graw Hill, New Delhi, India, 2006
- R2:** Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015



U19ECO004

**ADVANCED WIRELESS
COMMUNICATION**

L T P C
3 0 0 3

COURSE OBJECTIVES

- To expose the students to the importance of improving capacity of wireless channel using MIMO
- To enable understanding of channel impairment mitigation using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

PREREQUISITES

- Basic concepts of communication theory
- Basics of Computer Networks
- Limits and Continuity
- Basic concepts of Differentiation
- Basic concepts of Integration

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2							2	1	2	
CO2	3	2	2	2							2	1	2	
CO3	3	2	2	2							2	1	2	
CO4	3	2	2	2							2	1	2	
CO5	3	2	2	2							2	1	2	
CO6	3	2	2	2							2	1	2	

UNIT I CAPACITY OF WIRELESS CHANNELS 9

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II RADIO WAVE PROPAGATION 9

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods

UNIT III SPACE TIME BLOCK CODES 9

Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.



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UNIT IV **SPACE TIME TRELLIS CODES** **9**
Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

UNIT V **LAYERED SPACE TIME CODES** **9**
LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1:** Comprehend and appreciate the significance and role of this course in the present contemporary world
- CO2:** Apply the knowledge about the importance of MIMO in today's communication
- CO3:** Appreciate the various methods for improving the data rate of wireless communication system
- CO4:** Explain the working of layered space time transmitter and receiver
- CO5:** Describe various radio propagation techniques

TEXT BOOKS:

- T1:** Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London . www.artechhouse.com, ISBN 1-58053-865-7-2004
- T2:** Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, Cambridge University Press, 2003.

REFERENCE BOOKS:

- R1:** David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.
- R2:** Sergio Verdu — Multi User Detection, Cambridge University Press, 1998



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Total: 45 HOURS

COURSE OUTCOMES

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

- CO1: Expertise in various calibration techniques and signal types for sensors.
- CO2: Understand about the various sensors
- CO3: Apply the various sensors in the Automotive and Mechatronics applications
- CO4: Study the basic principles of various smart sensors.
- CO5: Implement the DAQ systems with different sensors for real time applications
- CO6: Understand about different sensors with applications

TEXT BOOKS:

- T1: Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
- T2: Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

- R1: Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
- R2: John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999
- R3: Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.



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COURSE OBJECTIVES

- Students will gain knowledge about different energy scenario
- To understand about the conventional energy sources.
- To understand about the non-conventional energy sources.
- To understand about the biomass energy sources.
- To learn the concept of energy conservation

PREREQUISITES

- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3		3		2		2		2		2	
CO2	2	1	3		3		2		2		2		2	
CO3	2	1	3		3		2		2		2		2	
CO4	2	1	3		3		2		2		2		3	
CO5	2	1	3		3		2		2		2		2	
CO6	2	1	3		3		2		2		2		3	

UNIT I**ENERGY**

9

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II**CONVENTIONAL ENERGY**

9

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants

UNIT III**NON-CONVENTIONAL ENERGY**

9

Solar energy, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, energy plantations. Wind energy, types of windmills, types of wind rotors, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV**BIOMASS ENERGY**

9

Biomass origin - Resources – Biomass estimation. Thermo chemical conversion – Biological conversion,– Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.



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UNIT V**ENERGY CONSERVATION****9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmarking and energy performance, material and energy balance, thermal energy management.

Total: 45 HOURS**COURSE OUTCOMES**

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

- CO1:** Understand energy scenario in India
- CO2:** Understand conventional Energy sources,
- CO3:** Understand Non- conventional Energy sources,
- CO4:** Understand biomass sources and develop design parameters for equipment to be used in Chemical process industries
- CO5:** Understand energy conservation in process industries
- CO6:** Understand about different energy technology

TEXT BOOKS:

- T1:** Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
- T2:** Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
- T3:** Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCE BOOKS:

- R1:** Nejat Veziroglu, Alternate Energy Sources, IT, McGraw Hill, New York.
- R2:** Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008
- R3:** El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.



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ENGLISH

U19ENOE02	ENGLISH for EMPLOYABILITY SKILLS (Common to ALL)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To hone the employability-related communication skills of the students on the foundations built during Executive
- To assist students in becoming well-versed, responsible, creative communicators.
- To develop students' knowledge of communication skills in the structure, elucidation, and delivery of messages in diverse cultural and global communities; and
- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To write responses appropriately, organize ideas, and use vocabulary accurately

CO/PO MAPPING													CO/PSO Mapping	
COs	PROGRAMME OUTCOMES (POs)												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1							2	2	2	3		2	1	
CO2								1	2	3		2	1	
CO3						2		2	3	3		2	1	
CO4							3	2	1	3		3	1	
CO5						3	3	3	3	3		3	1	

PRE-REQUISITES: Nil

UNIT I 9

SWOT Analysis – Perception Management – Positive Attitude – Empathy – Altruism – Self Management - Etiquette: Social, Dinner, Corporate, Telephone and Netiquette – Interview Skills

UNIT II 9

Reading Comprehension: Technical passages –Kinds of sentences –Sentence correction – Error spotting – Idioms – Vocabulary: Jargon and Distractors – Punctuation errors – Online Course: Udemy, Edx, FutureLearn

UNIT III 9

Letter writing: Formal Letters – Letters accepting Offers - Chart description – process description – Essays — Internship Reports

UNIT IV 9

Self-Introduction - Talking about friends and Family –Resume Preparation: Single Page and Detailed– Persuasion Skills – Emotional Intelligence – Teamwork - Establishing Credibility: Understanding the Workplace – Body Language



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UNIT V

9

Industry Psychology: Characteristics of the workplace: Physical working conditions: Noise, Illumination, Colour, Music, Miscellaneous Factors; Work Schedules: Working Hours, Permanent Part-Time Employment, Flexible Work Schedules; Psychological and Social Issues - Stress management – Time management

Total: 45 HOURS

COURSE OUTCOME

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

- C01** Be prepared for the personal interview through mock interviews while being aware of the various kinds of interviews.
- C02** Introspect & develop a planned approach towards his career & life in general.
- C03** Have clarity on his career exploration process and match his skills and interests with a chosen career path.
- C04** Explain the use of a functional and chronological resume.
- C05** Develop thinking ability and polish his expression in group discussions.

TEXT BOOKS

- T1** Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.
- T2** Skills for Employability, Dr. M. Sen Gupta, ISBN: 978-81-933819-1-5, 2020, First Edition
- T3** Soft Skills & Employability Skills, SABINA PILLAI, AGNA FERNANDEZ, Cambridge, ISBN: 9781316981320, 1316981320, 2017

REFERENCE BOOKS

- R1** Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young, ASIN : 8126563435, ISBN-10 : 9788126563432, ISBN-13 : 978-8126563432, Pan Macmillan India; 2016
- R2** Soft Skills Training: A workbook to develop skills for employment, Amazon Digital Services; Large edition, 2012, ISBN-10: 1468096494, ISBN-13 : 978-1468096491
<https://www.sirc-icai.org/images/cabf/Soft%20Skills%20&%20Personality%20Development.pdf>
- R3** <http://worldwideuniversity.org/library/bookboon/soft-skills.pdf>
- R4** <https://www.futurelearn.com/subjects/business-and-management-courses/soft-skills>
- R5** skills

WEB RESOURCES

- W1** https://bharatskills.gov.in/pdf/E_Books/EmployabilitySkillsSWB2W.pdf
- W2** <https://link.springer.com/book/10.1007/978-3-319-75166-5>
- W3** https://cbseacademic.nic.in/web_material/Curriculum21/publication/secondary/Employability_Skills10.pdf
- W4** <https://www.oreilly.com/library/view/soft-skills-for/9781119875536/>



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B.TECH FOOD TECHNOLOGY

U19FTOE003

BEVERAGE TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

Impart knowledge on processing and ingredients applied for beverage preparation according to the standard categorization of beverages. Based on the ingredients incorporated and type of processing method applied will give a classification of beverages. Sanitization schemes and quality control measures according to standards and regulations.

PREREQUISITES

- Basic classification of beverages in the market
- Storage and preparation of beverages
- Purpose of preparing beverages
- Market and trends in beverages sector

UNIT I

INGREDIENTS IN BEVERAGES

9+3

Beverage-definition--ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II

CARBONATED BEVERAGES

9+3

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipments and machineries- -containers and closures. low-calorie and dry beverages; isotonic and sports drinks; Fruit based carbonated beverages, carbonated water

UNIT III

NON-CARBONATED BEVERAGES

9+3

Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy based beverages, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages. bottled. Water; mineral water, natural spring water, flavored water.

UNIT IV

ALCOHOLIC BEVERAGES

9+3

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment's used for brewing and distillation, wine and related beverages, distilled spirits

UNIT V

SANITATION AND QUALITY CONTROL

9+3

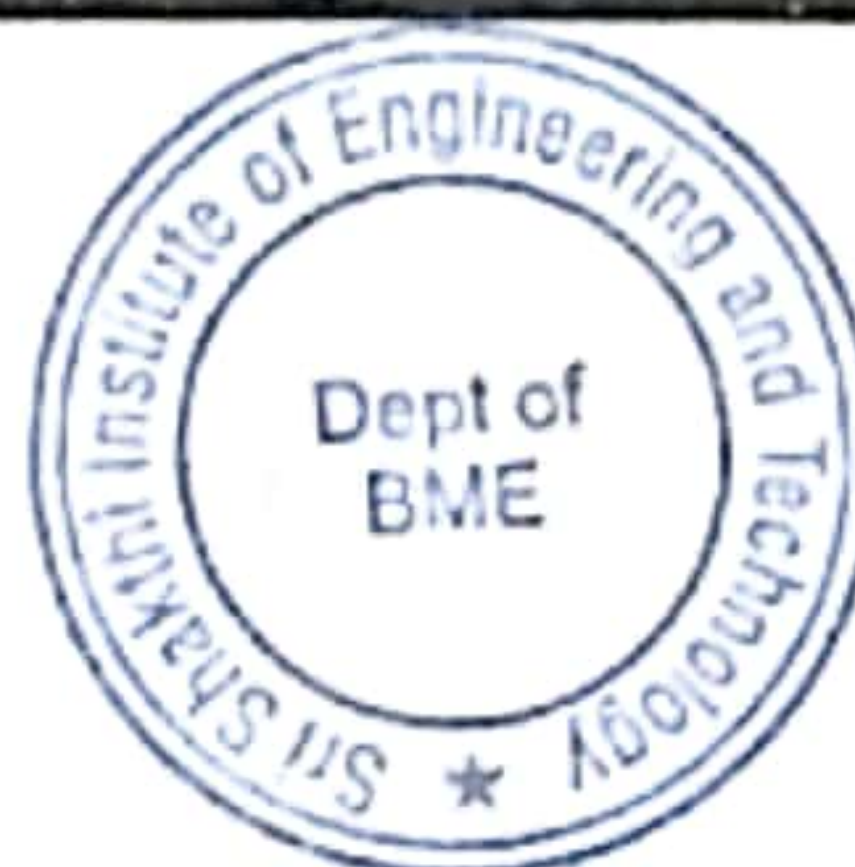
Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry- Quality of water used in beverages threshold limits of ingredients. FSSAI, EFSA and FDA regulations

Total: 60 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1: Capable of formulating beverages using various ingredients.
- CO2: Demonstrate various unit operations involved in the food beverage manufacturing
- CO3: Understand the various production techniques in beverages
- CO4: Evaluate the quality parameters of all beverages
- CO5: Familiarize with food laws and regulations of beverages
- CO6: Understand the natural and artificial colourants used in beverages



CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											1	
2	1	3											1	
3	1			3									2	
4					3			2					2	
5					3			2					1	
6	1	1		2									1	

TEXT BOOKS:

- T1: Jagan Mohan Rao and K.Ramalakshmi (2011) "Recent trend in Soft beverages", Woodhead Publishing India Pvt Ltd.
- T2: Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.

REFERENCE BOOKS:

- R1: Liu, Yiu H., et al., eds. (2004) Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.
- R2: Mitchell, Alan J. (199) "Formulation and Production Carbonated Soft Drinks". Springer Science & Business Media.
- R3: Woodroof, Jasper Guy, and G. Frank Phillips. (1981) Beverages: carbonated and noncarbonated. AVI Pub. Co



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U19FTOE004

**PROCESSING OF FOOD
MATERIALS**

L T P C
3 0 0 3

COURSE OBJECTIVES

Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds. Summarize the production and processing methods of fruits and vegetables and to discuss the chemical composition, processing, production, spoilage and quality of milk and milk product. Outline the overall processes involved in the production of meat, poultry and fish products Review the production and processing methods of plantation and spice products

PREREQUISITES

- Need an idea of nature of food materials to be handled
- Prior storage conditions before processing the materials
- Basic handling techniques of materials
- Preparation of materials prior to processing

UNIT I CEREAL, PULSES AND OIL SEEDS TECHNOLOGY 9+3

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

UNIT II FRUITS AND VEGETABLE PROCESSING 9+3

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

UNIT III DAIRY PROCESSING 9+3

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipment - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products – Ice cream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

UNIT IV MEAT, POULTRY AND FISH PROCESSING 9+3

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing.

UNIT V PLANTATION PRODUCT TECHNOLOGY 9+3

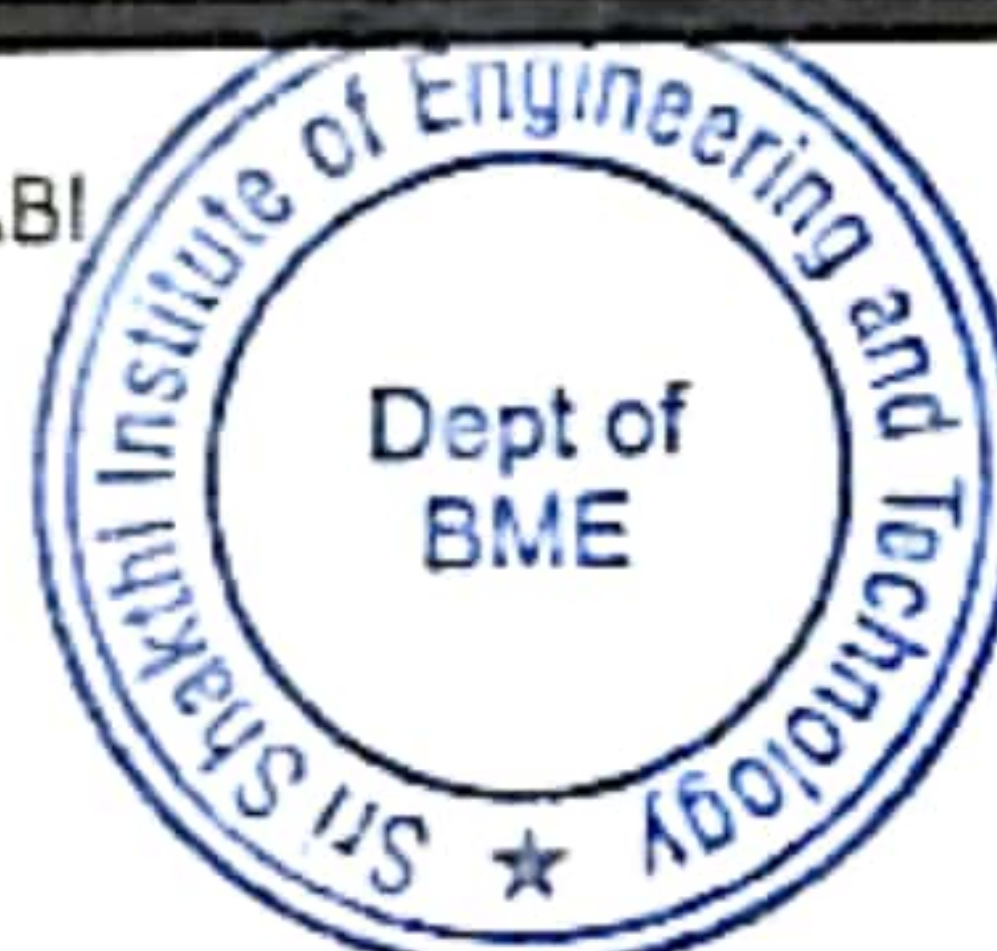
Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

Total: 60 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

- CO1: Discuss the various processing technologies involved in cereal, pulses and oilseed technology
- CO2: Demonstrate the major operations applied in fruits and vegetable processing
- CO3: Illustrate the techniques involved in the processing of dairy products
- CO4: List the overall processing of meat, poultry and fish processing
- CO5: Outline the processing of spices and plantation products
- CO6: Analyse the manufacturing methods involved in various byproducts of food materials



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CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2													
2	1	3		3											
3	1													1	
4						3			2					1	
5						3			2						
6	1	1		2											

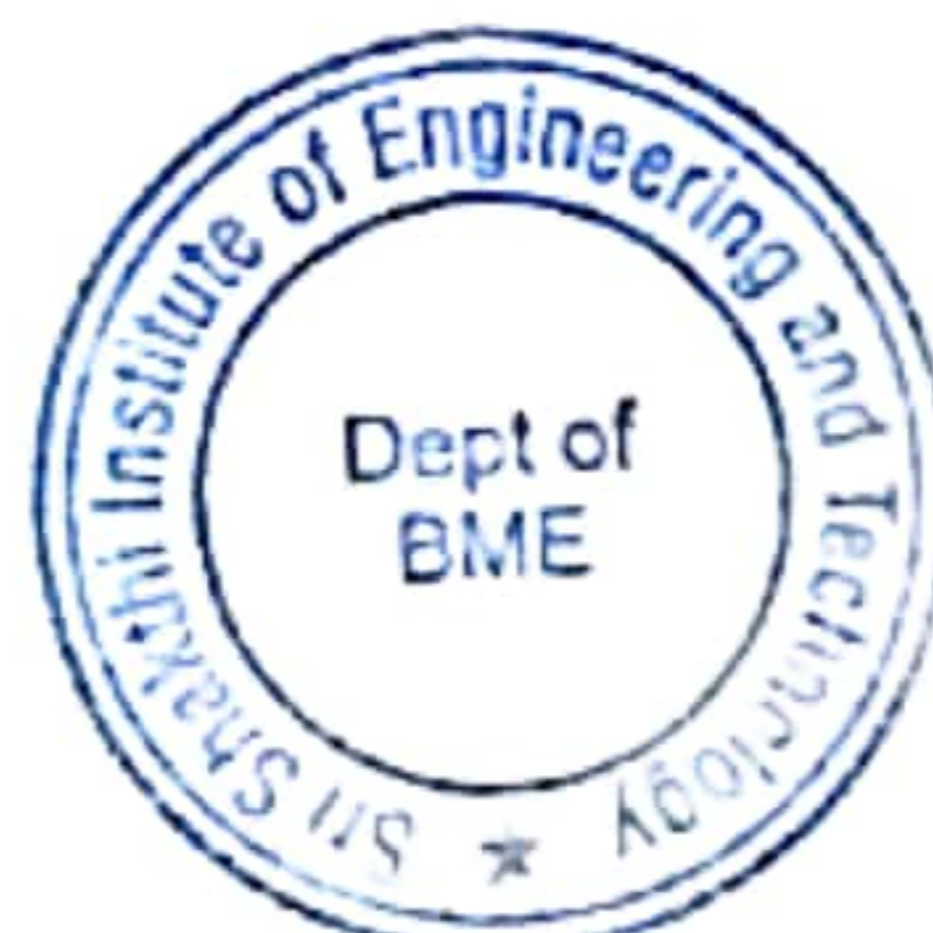
3 - High, 2 - Medium, 1 - Low

TEXT BOOKS:

- T1: Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition. 2010.
Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S.
- T2: Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition. 2003.

REFERENCE BOOKS:

- R1: Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.



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B.TECH INFORMATION TECHNOLOGY

L T P C

U19ITOE003

FOUNDATION OF INFORMATION TECHNOLOGY

3 0 0 3

COURSE OBJECTIVES

- Understand the basic concepts and terminology of information technology
- Identify the components of a computer system and their functions
- Describe different types of software and their applications
- Explain the principles of computer networking and internet technologies
- Understand the basics of database design and management
- Use IT effectively in personal and professional settings

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3			2		2		3	2	3		
2	3		3			2		2		3	2	3		
3	3		3			2		2		3	2	3		
4	3		3			2		2		3	2	3		
5	3		3			2		2		3	2	3		
6	3		3			2		2		3	2	3		

UNIT I: Basics of Information Technology

9

Internet: World Wide Web, Web servers, Web Clients, Web sites, Web Pages, Web Browsers, Blogs, News groups, HTML, Web address, E-mail address, URL, HTTP, FTP, downloading and uploading files from remote site; Services available on Internet: Information Retrieval, Locating sites using search engines and finding people on the net; Web Services: Chat, email, Video Conferencing, e-Learning, e-Banking, e-Shopping, e-Reservation, e-Governance, e-Groups, Social Networking

UNIT II: Information Processing Tools

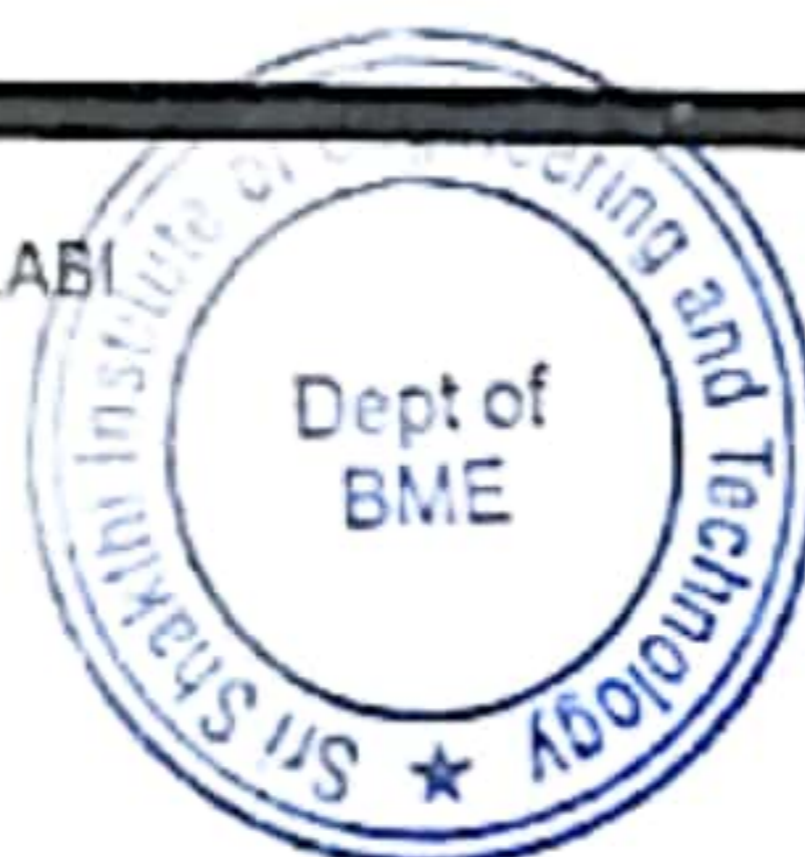
9

Office Tools: Database Management Tool: Basic Concepts and need for a database, Creating a database. DataTypes-Text, Number, Date, Time, Setting the Primary Key, Entering data into a database, Inserting and deleting Fields, Inserting and deleting Records, Field Size, Default Value, Creating Query using Design view.

UNIT III: Hyper Text Markup Language

9

Introduction to Web Page Designing using HTML, Creating and saving an HTML document, accessing a web page using a web browser (Google Chrome, Internet Explorer, Mozilla Firefox, Opera, Apple Safari, Net scape Navigator); Elements in HTML.



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UNIT IV: XML

9

Introduction to XML, Difference between XML and HTML with respect to the following: Data separation, data sharing, document structure, tags, nesting of elements, attributes, values. XML Elements - Defining own tags in XML, root elements, child elements and their attributes; Comments in XML, White space and new line in XML, well formed XML documents, validating XML documents, XML Parser, Viewing XML documents in a web browser.

UNIT V: Societal Impacts of IT

9

Information Security: Virus, Worms, Trojans and Anti-Virus Software, Spyware, Malware, Spams, Data Backup and recovery tools and methods, Online Backups, Hacker and Cracker with regard to Computer Data and Applications, Social Networking Information security provisions in e-commerce, Benefits of ICT in Education, Healthcare, Governance, Virtual, School, emergence of Knowledge economy, Impact of ICT on Society: Knowledge based society, Infomania, Digital Unity and Digital Divide

Total: 45 HOURS

TEXT BOOKS

1. Introduction to Information Technology" by Turban, Rainer, and Potter (Wiley, 2015)
2. Discovering Computers" by Vermaat, Sebok, and Freund (Cengage Learning, 2019)

REFERENCE BOOKS

1. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)
2. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Understand fundamental concepts, principles, and applications of information technology

CO2: Understand the different types of software and their applications

CO3: Understand the basics of database design and management.

CO4: Understand the role of information systems in organizations and their applications

CO5: Understand the principles of computer networking and internet technologies

CO6: Apply IT effectively in personal and professional settings.



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U19ITOE004

WEB DESIGN AND MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To Learn the basic concepts in HTML, CSS, Javascript.
- To Understand the responsive design and development.
- To Understand the responsive design and development.
- To Design a Website with HTML, JS, CSS / CMS - Word press.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3		3	3	2		3		3	3		1
2	3		3		3	3	2		3		3	3		1
3	3		3		3	3	2		3		3	3		2
4	3		3		3	3	2		3		3	3		2
5	3		3		3	3	2		3		3	3		1
6	3		3		3	3	2		3		3	3		1

UNIT I: WEB DESIGN - HTML MARKUP FOR STRUCTURE 9

Working of Web - HTML Markup for Structure - Creating simple page - Marking up text - Adding Links - Adding Images - Table Markup - Forms - HTML5

UNIT II: CSS AND JAVASCRIPT 9

CSS - Formatting text - Colours and Background - Padding, Borders and Margins - Floating and positioning - Page Layout with CSS - Transition, Transforms and Animation - Javascript - Using Java Script

UNIT III: RESPONSIVE WEB DESIGN 9

Sass for Responsive Web Design - Marking Content with HTML5 - Mobile-First or Desktop-First - CSS Grids, CSS Frameworks, UI Kits, and Flexbox for RWD - Designing small UIs by Large Finger - Images and Videos in Responsive Web Design - Meaningful Typography for Responsive Web Design

UNIT IV: WEB PROJECT MANAGEMENT 9

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting - Running the project - Technical Documentation - Development ,Communication, Documentation - QA and testing -Deployment - Support and operations

UNIT V: PROJECT CASE STUDY 9

Using HTML, CSS, JS or using Opensource CMS like Wordpress, design and develop a Website having Aesthetics, Advanced and Minimal UI Transitions based on the project - Host and manage the project live in any public hosting.



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Total: 45 HOURS

TEXT BOOKS

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015
3. Justin Emond, Chris Steins, "Pro Web Project Management", Apress,2011

REFERENCE BOOKS

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014
2. Jon Duckett, Jack Moore, "JavaScript & JQuery: Interactive Front-End Web Development", John Wiley and Sons, edition 2014
3. Uttam K. Roy "Web Technologies" Oxford University Press, 13th impression, 2017
4. Wordpress - <http://www.wpbeginner.com/category/wp-tutorials/>

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Understand the principles of web design, including layout, color theory, typography, and user experience design.

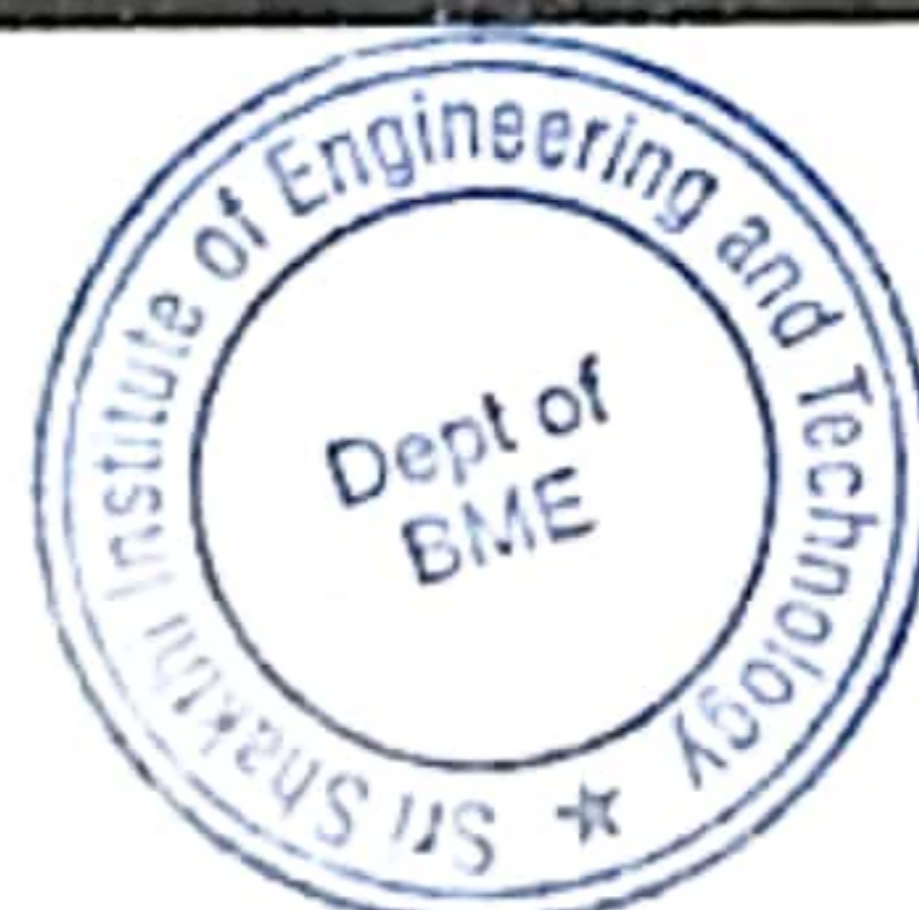
CO2: Design Website using HTML CSS and JS

CO3: Design Responsive Sites

CO4: Manage, Maintain and Support Web Apps

CO5: Gain practical experience working on real-world web design projects, and learn how to collaborate with clients, stakeholders, and team members.

CO6: Develop an understanding of web analytics and digital marketing, and learn how to use data to improve website performance and user engagement.



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Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.

Total: 45 Hours

COURSE OUTCOMES

At the end of the course students should have the ability to

- CO1 :** Apply the concepts of automobile architecture in an automobile assembly.
- CO2 :** Device the right choice of process parameters to fine tune the performance.
- CO3 :** Choose the right choice of transmission system as per the requirements
- CO4 :** Make the right choice of suspension system for the given application
- CO5 :** Visualize and understand the working mechanism of steering.

TEXT BOOKS

- T1. Gupta .R.B, "Automobile Engineering ", SatyaPrakashan, 2009.
- T2. Kirpal Singh, "Automobile Engineering Vol-I & II", Standard publishers, New Delhi, 2011.

REFERENCE BOOKS

- R 1. Julian Happian Smith, "An Introduction to Modern Vehicle Design", Butterworth-Heinemann, New Delhi, 2002
- R2. Crouse W H, "Automotive Transmissions and Power trains", McGraw Hill Book Co., New Delhi, 1976.
- R3 Heinz Heisler, "Vehicle and Engine Technology", SAE International and Elsevier, 1999.



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U19MEOE004

CAD/CAM

L T P C
3 0 0 3

COURSE OBJECTIVES

To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		3										
2	3	2		3				2						
3	3	3		3										
4	3	2		3				2						
5	3	2		3										

PRE-REQUISITES

Engineering Drawing

THEORY COMPONENT CONTENTS

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation.

UNIT II CURVES AND SURFACES MODELING 9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermitebicubic surface- Bezier surface and B-Spline surface- surface manipulations.

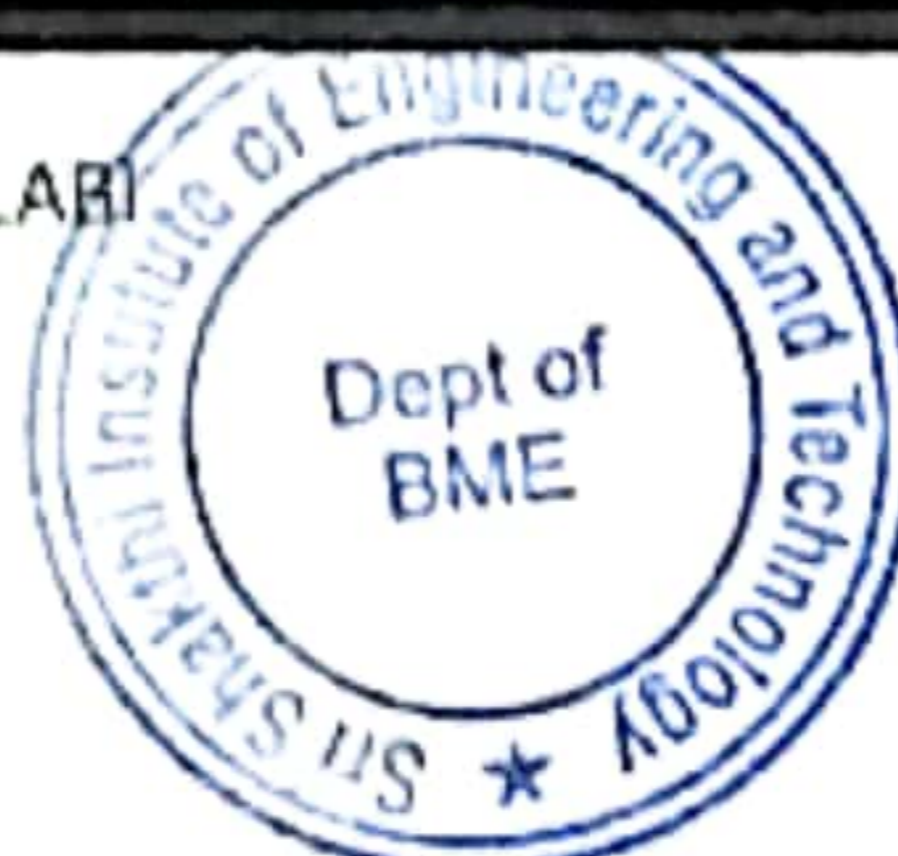
UNIT III NURBS AND SOLID MODELING 9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modelling.

UNIT IV VISUAL REALISM 9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

UNIT V ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE 9



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Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

Total:45 Hours

COURSE OUTCOMES

At the end of the course students should be able to

- CO1 :** Understand the fundamentals of computer graphics.
- CO2 :** Apply different techniques for geometric modelling.
- CO3 :** Apply different algorithm to create prismatic and lofted parts.
- CO4 :** Discuss tolerance analysis and mass property calculations.
- CO5 :** Explain data exchange standards and communication standards.

TEXT BOOKS

- T1.** David F. Rogers, James Alan Adams, “Mathematical elements for computer graphics”, second edition, Tata McGraw-Hill edition.
- T2.** Ibrahim Zeid, “Mastering CAD/CAM”, McGraw Hill, International Edition, 2007.

REFERENCE BOOKS

- R 1.** Donald Hearn and M. Pauline Baker, “Computer Graphics” Prentice Hall, Inc., 1992.
- R2.** William M Neumann and Robert F.Sproul, “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.



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U19CHOE001

ENVIRONMENTAL SCIENCES

L T P C
3 0 0 3

Course Objective

The student should be made:

- To study the nature and facts about environment management
- To finding and implementing scientific, technological, economic and political solutions to environmental problems
- To study the interrelationship between living organism and environment
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value
- To study the dynamic processes and understand the features of the earth's interior and surface
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01						3	3						2	
C02						3	3						2	
C03						3	3						2	
C04						3	3						2	
C05						3	3						3	
C06						3	3						2	

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – 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 conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.



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UNIT III**NATURAL RESOURCES****10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

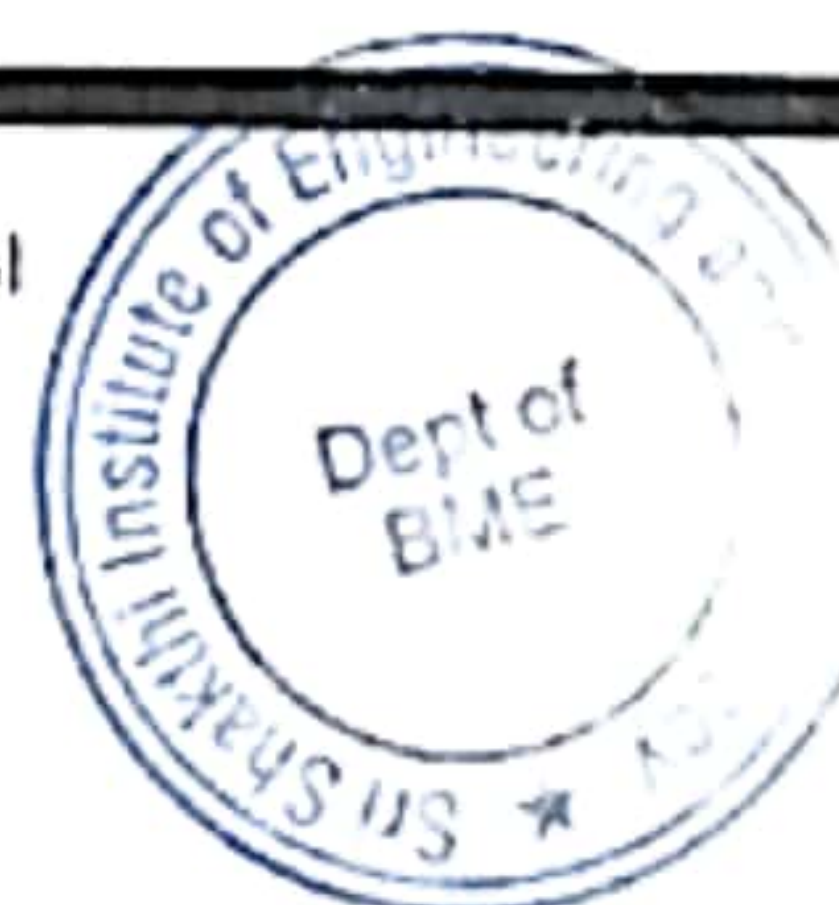
UNIT V HUMAN POPULATION AND THE ENVIRONMENT**6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

Total:45 HOURS**COURSE OUTCOMES**

At the end of the course students should be able to

- CO1:** Awareness on environmental factors
- CO2:** Finds scientific, technological, economic and political solutions to environmental problems
- CO3:** Knowledge on interrelationship between living organism and environment
- CO4:** Assess impact on the human world envision the surrounding environment, its functions and its value
- CO5:** Knowledge on the dynamic processes and understand the features of the earth's interior and surface
- CO6:** Understands the integrated themes and biodiversity, natural resources, pollution control and waste management.



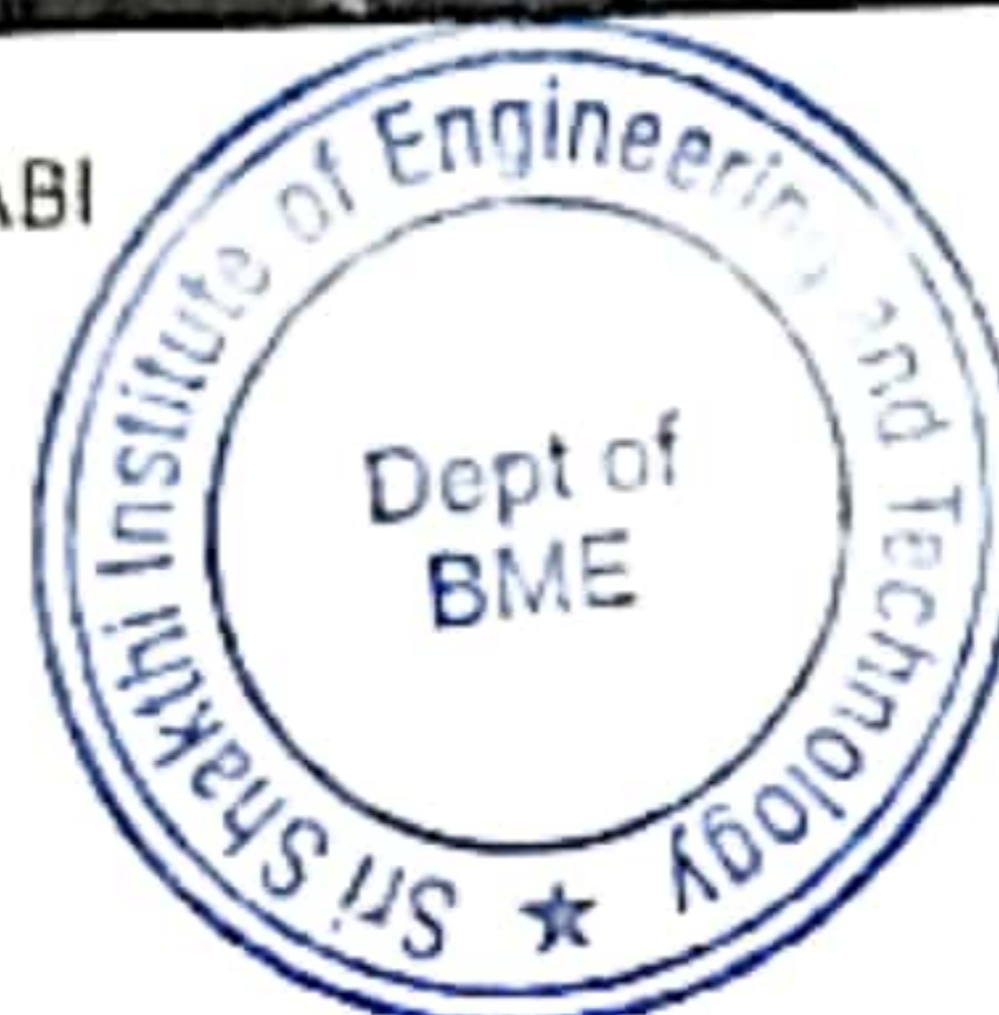
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TEXTBOOKS:

- T1** Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
- T2** Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCEBOOKS:

- R1** Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
- R2** Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hyderabad, 2015.
- R3** G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt, Ltd, Delhi, 2014.
- R4** Rajagopalan.R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005



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COURSE OBJECTIVES

- To give an idea about IPR, registration and its enforcement.

PREREQUISITES

- Fundamentals of Products

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		3	2		2			2			2	2	
CO2	1		3	2		2			2			2	2	
CO3	1		3	2		2			2			2	2	
CO4	1		3	2		2			2			2	2	
CO5	1		3	2		2			2			2	2	
CO6	1		3	2		2			2			2	3	

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

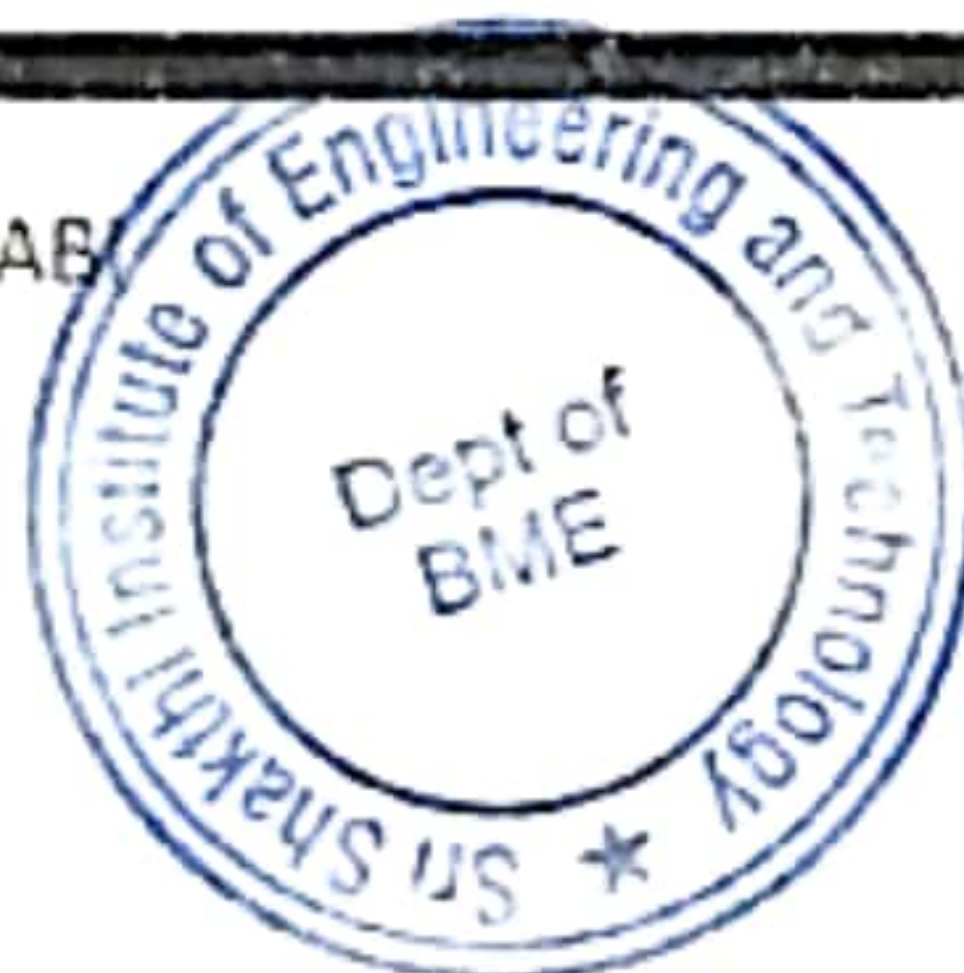
UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Total: 45 HOURS



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COURSE OUTCOMES

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

CO1: Ability to manage Intellectual Property portfolio to enhance the value of the firm.

CO.2: Ability to learn the registration of IPRs

CO.3: Ability to learn the agreements and legislations process

CO.4: Ability to understand the digital products and law

CO.5: Ability to learn the enforcement of IPRs.

CO6: Ability to patent filing and publishing

TEXT BOOKS:

T1: V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

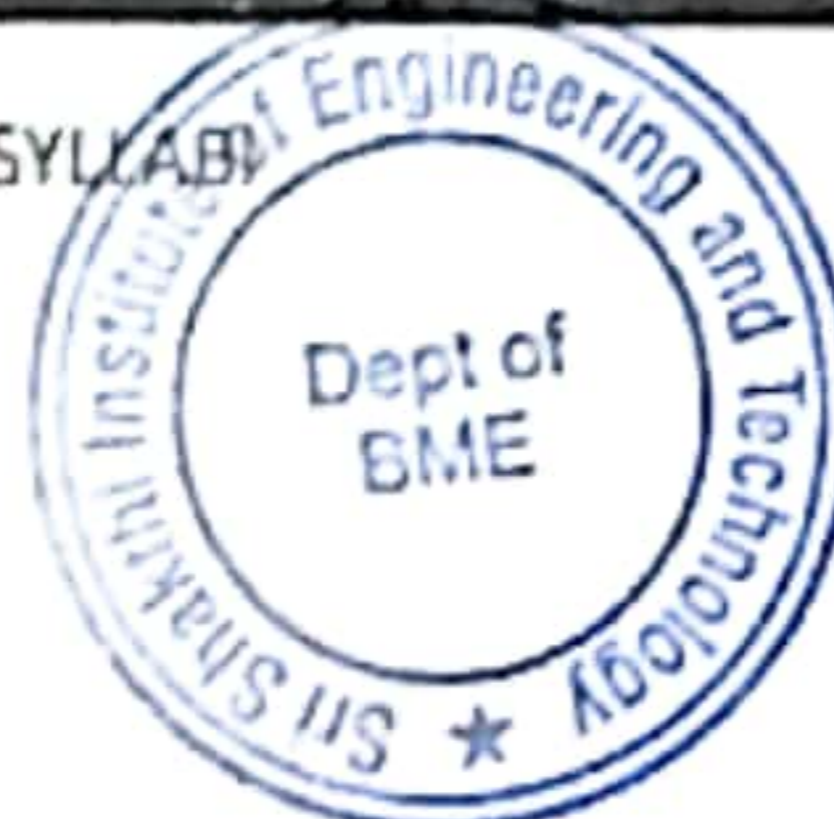
T2: S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCE BOOKS:

R1: Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.

R2: Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.

R3: Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.



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