AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR, CHENNAI

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

(Constituent Colleges of Vinayaka Mission's Research Foundation, Deemed to be University, Salem, Tamil Nadu, India)

(AICTE APPROVED AND NAAC ACCREDITED)

Faculty of Engineering and Technology

REGULATIONS 2017

DEPARTMENT OF BIOMEDICAL ENGINEERING

Programme:

B.E / B.Tech. BIOMEDICAL ENGINEERING

Full Time (4 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

CURRICULUM AND SYLLABUS

(Semester I to VIII)

VINAYAKA MISSION'S KIRUPANANDA VARIYAR

ENGINEERING COLLEGE, SALEM

DEPARTMENT OF BIOMEDICAL ENGINEERING

Vision

- To provide a unique multidisciplinary engineering environment in Biomedical Engineering that focuses on producing graduates who apply scientific knowledge and Engineering design principles to contribute the society by developing Biomedical technology need for national health care system.

Mission

- To create an environment in which students thrive to the best in rational design and implementation of medical device and application.
- To understand local medical problem and developing strategies to tackle these problem to improve human lives.
- To enhance the challenges of health care problems.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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	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	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	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	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	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	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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	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	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.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

Graduating Students of Electronics and Communication Engineering programme will be able to:

PSO1	Analyze, Plan and Design the equipment in multidomains of biomedical engineering.
PSO2	Hone their professional's expertise in quest for improved career opportunities through sustained learning.
PSO3	Work with ethical principles and sound managerial skills in the promotion of biomedical engineering infrastructure keeping in mind, patient health, instrument safety and sustainability of the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

PSO1	Graduates will demonstrate their skills in solving challenges ranging from design, development, problem solving to production support in health care sectors.
PSO2	Graduates will exhibit leadership, make decisions with social and ethical responsibilities, communicate effectively in multidisciplinary engineering environment.
PSO3	Graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout the careers.

Credit Requirement for the Course Categories

Sl. No.	Category of Courses	Credits to be earned Min – Max.
01	**A. Foundation Courses (FC)**	**54 – 81**
	i. Humanities and Sciences (English and Management Courses)	12 – 21
	ii. Basic Sciences (Maths, Physics and Chemistry Courses)	24 – 33
	iii. Engineering Sciences (Basic Engineering Courses)	18 – 27
02	**B. Core courses (CC) relevant to the chosen Programme of study.**	**81**
03	**C. Elective Courses (EC)**	**18 – 24**
	i. Programme Specific (Class Room or Online)	12 – 15
	ii. Open Elective (Class Room or Online)	6 – 9
04	**D. Project + Internship + Industry Electives (P + I + I)**	**18**
	i. Project	9
	ii. Internship	3
	iii. Industry Supported Courses	6
05	**E. Employability Enhancement Courses + Co - Curricular Courses + Extra Curricular Courses	**9 - 18**
	i. Employability Enhancement Courses (Personality Development Training, Participation in Seminars, Professional Practices, Summer Project, Case Study etc.)	3 - 6
	ii. Co - Curricular Courses (NCC, NSS, Sports, Games, Drills and Physical Exercises)	3 - 6
	iii. Extra Curricular Courses	3 - 6
	Minimum Credits to be earned	**180**

**** - Mandatory, Credits would be mentioned in Mark sheets but not included for CGPA Calculations. For overall CGPA calculations, a student has to earn minimum 171 credits in Categories A to D.**

CURRICULUM

B.E / B.Tech. BIOMEDICAL ENGINEERING

SEMESTER
I TO VIII

B.E / B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY A – FOUNDATION COURSES - HSS, BS AND ES COURSES - CREDITS (54-81)									
(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (12 - 21)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC (HSS)	3	0	0	3	NIL
2	17EGHS02	BUSINESS ENGLISH	ENGLISH	FC (HSS)	3	0	0	3	NIL
3	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC (HSS)	0	0	4	2	NIL
4	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC (HSS)	0	0	4	2	NIL
5	17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)									
1	17MABS01	ENGINEERING MATHEMATICS	MATHEMATICS	FC (BS)	2	2	0	3	NIL
2	17MABS06	DIFFERENTIAL EQUATIONS AND TRANSFORMS	MATHEMATICS	FC (BS)	2	2	0	3	NIL
3	17MABS12	STOCHASTIC PROCESS AND NUMERICAL METHODS	MATHEMATICS	FC (BS)	2	2	0	3	NIL
4	17PCBS02	PHYSICAL SCIENCES	PHYSICS	FC (BS)	4	0	0	4	NIL
5	17PHBS05	SMART MATERIALS	PHYSICS	FC (BS)	3	0	0	3	NIL
6	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS	FC (BS)	0	0	4	2	NIL
7	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEERING	CHEMISTRY	FC (BS)	3	0	0	3	NIL
8	17PHBS04	MEDICAL PHYSICS	PHYSICS	FC (BS)	3	0	0	3	NIL
(iii) ENGINEERING SCIENCES (BASIC ENGINEERING COURSES) - CREDITS (18 - 27)									
1	17CSES01	ESSENTIALS OF COMPUTING (Theory + Practice)	CSE	FC(ES)	2	0	2	3	NIL
2	17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE & ECE	FC(ES)	4	0	0	4	NIL
3	17CSES05	PROGRAMMING IN PYTHON	CSE	FC(ES)	3	0	0	3	NIL
4	17CSES83	PROGRAMMING IN PYTHON LAB	CSE	FC(ES)	0	0	4	2	NIL
5	17EEES82	ENGINEERING SKILLS PRACTICE LAB A. BASIC ELECTRICAL ENGINEERING B. BASIC ELECTRONICS ENGINEERING	EEE & ECE	FC(ES)	0	0	4	2	NIL
6	17CSES07	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING	CSE	FC(ES)	3	0	0	3	NIL
7	17CSES86	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING LAB	CSE	FC(ES)	3	0	4	2	NIL
8	17EEES04	ELECTRIC MACHINERY	EEE	FC(ES)	3	0	0	3	NIL

B.E / B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY B – CORE COURSES RELEVANT TO THE PROGRAMME - CREDITS (81)									
SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17ECCC01	SEMICONDUCTOR DEVICES	ECE	CC	3	0	0	3	NIL
2	17BTCC01	ESSENTIALS OF BIOCHEMISTRY	BTE	CC	3	0	0	3	NIL
3	17BMCC01	BIOMEDICAL CIRCUITS & NETWORKS	BME	CC	3	0	0	3	17EEES03
4	17BMCC02	HUMAN ANATOMY AND PHYSIOLOGY	BME	CC	4	0	0	4	NIL
5	17BMCC03	BIOSENSORS AND TRANSDUCERS	BME	CC	3	0	0	3	NIL
6	17ECCC02	ANALOG CIRCUITS	ECE	CC	3	0	0	3	17ECCC01
7	17ECCC05	DIGITAL LOGIC CIRCUITS & DESIGN	ECE	CC	3	0	0	3	17EEES03
8	17ECCC04	SIGNALS AND SYSTEMS	ECE	CC	3	0	0	3	NIL
9	17BMCC04	BIOMEDICAL INSTRUMENTATION & MEASUREMENTS	BME	CC	3	0	0	3	NIL
10	17BMCC05	PATHOLOGY AND MICROBIOLOGY	BME	CC	3	0	0	3	NIL
11	17ECCC10	LINEAR INTEGRATED CIRCUITS	ECE	CC	3	0	0	3	17EEES03 & 17ECCC02
12	17BMCC06	BIOMEDICAL CONTROL SYSTEMS	BME	CC	3	0	0	3	17MABS06
13	17ECCC07	MICROCONTROLLERS & ITS APPLICATIONS	ECE	CC	3	0	0	3	NIL
14	17BMCC07	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS - I	BME	CC	3	0	0	3	17BMCC04
15	17BMCC08	BIOMEDICAL SIGNAL PROCESSING	BME	CC	3	0	0	3	17ECCC04
16	17BMCC09	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS - II	BME	CC	3	0	0	3	17BMCC07
17	17BMCC10	MEDICAL IMAGE PROCESSING AND ANALYSIS	BME	CC	3	0	0	3	17BMCC08
18	17BMCC11	REHABILITATION ENGINEERING	BME	CC	3	0	0	3	NIL
19	17ECCC81	SEMICONDUCTOR DEVICES LAB	ECE	CC	0	0	4	2	NIL
20	17BTCC81	BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
21	17ECCC82	DIGITAL LOGIC CIRCUITS & DESIGN LAB	ECE	CC	0	0	4	2	NIL
22	17ECCC83	ANALOG CIRCUITS LAB	ECE	CC	0	0	4	2	NIL
23	17BMCC81	BIO TRANSDUCERS LAB	BME	CC	0	0	4	2	NIL
24	17ECCC94	LINEAR INTEGRATED CIRCUITS LAB	ECE	CC	0	0	4	2	NIL
25	17BMCC82	BIOMEDICAL INSTRUMENTATION LAB	BME	CC	0	0	4	2	NIL
26	17BMCC83	PATHOLOGY AND MICROBIOLOGY LAB	BME	CC	0	0	4	2	NIL
27	17ECCC95	MICROCONTROLLERS LAB	ECE	CC	0	0	4	2	NIL
28	17BMCC84	BIOMEDICAL SIGNAL AND IMAGE PROCESSING LAB	BME	CC	0	0	4	2	NIL
29	17BMCC85	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS LAB	BME	CC	0	0	4	2	NIL
30	17BMCC86	HOSPITAL TRAINING – I	BME	CC	0	0	4	2	NIL
31	17BMCC87	HOSPITAL TRAINING – II	BME	CC	0	0	4	2	17BMCC86

B.E / B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY C – ELECTIVE COURSES - CREDITS (18 - 24)									
(i) PROGRAMME SPECIFIC (CLASS ROOM OR ONLINE) - CREDITS (12 - 15)									
SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17BMEC01	MEDICAL OPTICS	BME	EC - PS	3	0	0	3	NIL
2	17BMEC02	BIOTELEMETRY	BME	EC - PS	3	0	0	3	NIL
3	17BMEC03	BIOMETRIC SYSTEMS	BME	EC - PS	3	0	0	3	17BMCC10
4	17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	BME	EC - PS	3	0	0	3	NIL
5	17BMEC05	HOME MEDICARE TECHNOLOGY	BME	EC - PS	3	0	0	3	NIL
6	17BMEC06	APPLIED NEURAL NETWORKS AND FUZZY LOGICSYSTEMS IN MEDICINE	BME	EC - PS	3	0	0	3	NIL
7	17BMEC07	TROUBLESHOOTING AND QUALITY CONTROL IN MEDICAL EQUIPMENTS	BME	EC - PS	3	0	0	3	NIL
8	17BMEC08	EMBEDDED SYSTEMS IN MEDICAL APPLICATIONS	BME	EC - PS	3	0	0	3	NIL
9	17BMEC09	DESIGN OF MEDICAL DEVICES	BME	EC - PS	3	0	0	3	NIL
10	17BMEC10	BODY AREA NETWORKS AND MOBILE HEALTHCARE	BME	EC - PS	3	0	0	3	NIL
11	17BMEC11	NUCLEAR MEDICINE TECHNOLOGY	BME	EC - PS	3	0	0	3	17BMCC02
12	17BMEC12	HOSPITAL MANAGEMENT	BME	EC - PS	3	0	0	3	NIL
13	17BMEC13	PRINCIPLES OF TISSUE ENGINEERING	BME	EC - PS	3	0	0	3	NIL
14	17BMEC14	RADIOLOGICAL EQUIPMENTS	BME	EC - PS	3	0	0	3	NIL
15	17BMEC15	APPLIED OPTOELECTRONICS IN MEDICINE	BME	EC - PS	3	0	0	3	NIL
16	17BMEC16	THERAPEUTIC & SURGICAL EQUIPMENTS	BME	EC - PS	3	0	0	3	17BMCC04
17	17BMEC17	MEDICAL IMAGING TECHNIQUES	BME	EC - PS	3	0	0	3	NIL
18	17BMEC18	ARTIFICIAL INTELLIGENCE & PATTERN RECOGNITION	BME	EC - PS	3	0	0	3	NIL
19	17BMEC19	PICTURE ARCHIVING AND COMMUNICATION SYSTEMS	BME	EC - PS	3	0	0	3	NIL
20	17BMEC20	HOSPITAL INFORMATION SYSTEM	BME	EC - PS	3	0	0	3	NIL
21	17BMEC21	MEDICAL SIMULATION IN LIFE SUPPORTING DEVICES	BME	EC - PS	3	0	0	3	NIL
22	17BMEC22	MEDICAL ETHICS AND STANDARDS	BME	EC - PS	3	0	0	3	NIL
23	17BMEC23	TELE HEALTH TECHNOLOGY	BME	EC - PS	3	0	0	3	NIL
24	17BMEC24	MACHINE LEARNING TECHNIQUES IN MEDICINE	BME	EC - PS	3	0	0	3	NIL
25	17BMEC25	ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE	BME	EC - PS	3	0	0	3	NIL

B.E / B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII DETAILS OF ELECTIVE COURSES FOR DEGREE WITH SPECIALISATION									
CATEGORY C – ELECTIVE COURSES									
SPECIALISATION – HOSPITAL MANAGEMENT									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17BMSE01	QUALITY MANAGEMENT IN HEALTHCARE	BME	EC - SE	3	0	0	3	NIL
2	17BMSE02	HOSPITAL ENGINEERING	BME	EC - SE	3	0	0	3	NIL
3	17BMSE03	TELEMEDICINE & PACs	BME	EC - SE	3	0	0	3	NIL
4	17BMSE04	HOSPITAL INFORMATION SYSTEM AND ITS MANAGEMENT	BME	EC - SE	3	0	0	3	NIL
5	17BMSE05	HEALTH TECHNOLOGY MANAGEMENT AND ECONOMICS	BME	EC - SE	3	0	0	3	NIL
6	17BMSE06	PATIENT SAFETY & RISK MANAGEMENT IN HOSPITAL	BME	EC - SE	3	0	0	3	NIL
7	17BMSE07	MEDICAL RADIATION SAFETY ENGINEERING	BME	EC - SE	3	0	0	3	NIL
8	17BMSE08	MEDICAL INFORMATICS	BME	EC - SE	3	0	0	3	NIL
9	17BMSE09	HOSPITAL MANAGEMENT DESIGN LAB	BME	EC - SE	0	0	4	2	NIL
10	17BMSE10	DATA ACQUISITION AND PROCESSING LAB	BME	EC - SE	0	0	4	2	NIL
SPECIALISATION – IMPLANTS & REHABILITATION ENGINEERING									
1	17BMSE11	THERAPEUTIC EQUIPMENTS	BME	EC - SE	3	0	0	3	NIL
2	17BMSE12	ASSIST DEVICES	BME	EC - SE	3	0	0	3	NIL
3	17BMSE13	BIOMECHANICS	BME	EC - SE	3	0	0	3	NIL
4	17BMSE14	NEURAL ENGINEERING	BME	EC - SE	3	0	0	3	NIL
5	17BMSE15	BIOMATERIALS AND ARTIFICIAL ORGANS	BME	EC - SE	3	0	0	3	NIL
6	17BMSE16	WEARABLE TECHNOLOGY	BME	EC - SE	3	0	0	3	NIL
7	17BMSE17	BRAIN COMPUTER INTERFACE	BME	EC - SE	3	0	0	3	NIL
8	17BMSE18	ROBOTICS & AUTOMATION IN MEDICINE	BME	EC - SE	3	0	0	3	NIL
9	17BMSE19	ASSIST DEVISES LAB	BME	EC - SE	0	0	4	2	NIL
10	17BMSE20	THERAPEUTIC EQUIPMENTS LAB	BME	EC - SE	0	0	4	2	NIL
SPECIALISATION – CLINICAL ENGINEERING									
1	17BMSE21	QUALITY CONTROL IN BIOMEDICAL ENGINEERING	BME	EC - SE	3	0	0	3	NIL
2	17BMSE22	CRITICAL CARE INSTRUMENTS AND THERAPEUTIC EQUIPMENT	BME	EC - SE	3	0	0	3	NIL
3	17BMSE23	MEDICAL WASTE MANAGEMENT	BME	EC - SE	3	0	0	3	NIL
4	17BMSE24	MEDICAL TECHNOLOGY AND ENTREPRENEURSHIP	BME	EC - SE	3	0	0	3	NIL
5	17BMSE25	ACTION PLAN DEVELOPMENT AND INTERVENTION	BME	EC - SE	3	0	0	3	NIL
6	17BMSE26	LAB VIEW DESIGN FOR MEDICAL SYSTEM AND IMAGING	BME	EC - SE	3	0	0	3	NIL
7	17BMSE27	MEDICAL IMAGING EQUIPMENTS	BME	EC - SE	3	0	0	3	NIL
8	17BMSE28	NANO TECHNOLOGY IN	BME	EC - SE	3	0	0	3	NIL

		MEDICINE							
9	17BMSE29	MEDICAL IMAGING LAB	BME	EC - SE	0	0	4	2	NIL
10	17BMSE30	GRAPHICAL SYSTEM DESIGN FOR BIOMEDICAL ENGINEERS	BME	EC - SE	0	0	4	2	NIL

(ii) OPEN ELECTIVE (CLASS ROOM OR ONLINE) - CREDITS (6 - 9)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17ECCC18	INTERNET OF THINGS FOR ELECTRONICS	ECE	EC - OE	3	0	0	3	NIL
2	17ECCC06	ELECTRONICS MEASUREMENT AND INSTRUMENTATION	ECE	EC - OE	3	0	0	3	NIL
3	17ECCC11	DATA COMMUNICATION NETWORKS	ECE	EC - OE	3	0	0	3	NIL
4	17ECCC15	ANALOG & DIGITAL COMMUNICATION	ECE	EC - OE	3	0	0	3	NIL
5	17ECCC16	MICROWAVE & OPTICAL COMMUNICATION SYSTEMS	ECE	EC - OE	3	0	0	3	NIL
6	17ECCC17	FPGA SYSTEM DESIGN	ECE	EC - OE	3	0	0	3	NIL
7	17ECEC21	ADVANCED ROBOTICS	ECE	EC - OE	3	0	0	3	NIL
8	17ECEC23	INTRODUCTION TO MACHINE VISION	ECE	EC - OE	3	0	0	3	NIL
9	17EEEC18	RENEWABLE ENERGY TECHNOLOGY	EEE	EC - OE	3	0	0	3	NIL
10	17EEEC20	MATHEMATICAL MODELLING AND SIMULATION	EEE	EC - OE	3	0	0	3	NIL
11	17EEEC21	NON-CONVENTIONAL ENERGY SOURCES	EEE	EC - OE	3	0	0	3	NIL
12	17CSCC04	COMPUTER ARCHITECTURE	CSE	EC - OE	3	0	0	3	NIL
13	17CSCC03	DATABASE MANAGEMENT SYSTEM	CSE	EC - OE	3	0	0	3	NIL
14	17CSCC19	INTERNET OF THINGS	CSE	EC - OE	3	0	0	3	NIL
15	17CSCC33	PROBLEM SOLVING USING COMPUTERS	CSE	EC - OE	3	0	0	3	NIL
16	17CSEC09	ETHICAL HACKING	CSE	EC - OE	3	0	0	3	NIL
17	17CSEC11	GREEN COMPUTING	CSE	EC - OE	3	0	0	3	NIL
18	17CSEC24	OPEN SOURCE SYSTEMS	CSE	EC - OE	3	0	0	3	NIL
19	17CSEC32	VIRTUAL REALITY	CSE	EC – PS	3	0	0	3	NIL
20	17CSEC33	VIRTUALIZATION TECHNIQUES	CSE	EC - OE	3	0	0	3	NIL
21	17CSEC34	WEB DESIGN AND MANAGEMENT	CSE	EC - OE	3	0	0	3	NIL
22	17CSEC06	CRYPTOGRAPHY AND NETWORK SECURITY	CSE	EC - OE	3	0	0	3	NIL
23	17BTEC03	PRINCIPLES OF BIO-INFORMATICS	BTE	EC - OE	3	0	0	3	NIL
24	17BTCC08	BIOINSTRUMENTATION	BTE	EC - OE	3	0	0	3	NIL
25	17BTEC19	CLINICAL TRIALS	BTE	EC - OE	3	0	0	3	NIL
26	17BTEC23	NANO BIOTECHNOLOGY	BTE	EC - OE	3	0	0	3	NIL
27	17BTEC29	GREEN BUILDING AND SUSTAINABLE ENVIRONMENT	BTE	EC - OE	3	0	0	3	NIL
28	17BTEC30	NATURAL RESOURCES MANAGEMENT	BTE	EC - OE	3	0	0	3	NIL
29	17CVEC07	DISASTER MITIGATION AND MANAGEMENT	CIVIL	EC - OE	3	0	0	3	NIL
30	17CVEC09	HOUSING PLANNING AND MANAGEMENT	CIVIL	EC - OE	3	0	0	3	NIL
31	17CVEC18	WIND ENGINEERING	CIVIL	EC - OE	3	0	0	3	NIL
32	17MECC03	ENGINEERING MECHANICS	MECH	EC - OE	3	0	0	3	NIL
33	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	EC - OE	3	0	0	3	NIL

34	17MBHS03	ENGINEERING MANAGEMENT AND ETHICS	MANAGEMENT	EC - OE	3	0	0	3	NIL
35	17MBHS05	MARKETING TECHNIQUES FOR ENGINEERS	MANAGEMENT	EC - OE	3	0	0	3	NIL

B.E / B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII

CATEGORY D – PROJECT + INTERNSHIP + INDUSTRY ELECTIVES (P + I + I) - CREDITS (18)

(i) PROJECT - CREDITS (9)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17BMPI01	PROJECT WORK AND VIVA VOCE	BME	PI	0	0	18	9	NIL

(ii) INTERNSHIP + MINI PROJECT + INDUSTRY ELECTIVES - CREDITS (9)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17BMPI02	MINI PROJECT	BME	PI	0	0	6	3	NIL
2	17BMPI03	INTERNSHIP	BME	PI	0	0	6	3	NIL
3	17BMPI04	TROUBLESHOOTING OF MEDICAL INSTRUMENTS	BME	PI	3	0	0	3	NIL
4	17BMPI05	RADIOTHERAPY EQUIPMENTS	BME	PI	3	0	0	3	NIL
5	17BMPI06	CARDIAC TECHNOLOGY	BME	PI	3	0	0	3	NIL
6	17BMPI07	OPERATION THEATRE AND ANESTHESIA TECHNOLOGY	BME	PI	3	0	0	3	NIL
7	17BMPI08	ACCIDENT & EMERGENCY CARE TECHNOLOGY	BME	PI	3	0	0	3	NIL
8	17BMPI09	LEARNING IT ESSENTIALS BY DOING	CSE	PI	3	0	0	3	NIL

B.TECH. – BIOMEDICAL ENGINEERING - SEMESTER I TO VIII

CATEGORY E – EMPLOYABILITY ENHANCEMENT COURSES, CO - CURRICULAR COURSES AND EXTRA CURRICULAR COURSES (EEC)** - CREDITS (9 - 18)

(- MANDATORY, CREDITS WOULD BE MENTIONED IN MARK SHEETS BUT NOT INCLUDED FOR CGPA CALCULATIONS.)**

(i) EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17APEE01	PERSONALITY SKILLS DEVELOPMENT - I	MATHS	EE	2 WEEKS OF TRAINING			1	NIL
2	17APEE02	PERSONALITY SKILLS DEVELOPMENT - II	ENGLISH	EE	2 WEEKS OF TRAINING			1	NIL
3	17BMEE01	TECHNICAL SKILLS DEVELOPMENT - I	BME	EE	2 WEEKS OF TRAINING			1	NIL
4	17BMEE02	TECHNICAL SKILLS DEVELOPMENT - II	BME	EE	2 WEEKS OF TRAINING			1	NIL
5	17BMEE03	TECHNICAL SKILLS DEVELOPMENT - III	BME	EE	2 WEEKS OF TRAINING			1	NIL
6	17BMEE04	TECHNICAL SKILLS DEVELOPMENT - IV	BME	EE	2 WEEKS OF TRAINING			1	NIL

(ii) CO - CURRICULAR COURSES (CCC)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17APEE03	NCC	NCC CELL	EE	2 WEEKS OF TRAINING IN NCC CAMP			1	NIL
2	17APEE04	NSS	NSS CELL	EE	2 WEEKS OF SOCIAL SERVICE IN NSS CAMP			1	NIL
3	17APEE05	SPORTS AND GAMES (INTER –UNIVERSITY LEVEL)	PHYSICAL EDUCATION	EE	--			1	NIL
4	17APEE06	SPORTS AND GAMES (INTRA-UNIVERSITY LEVEL)	PHYSICAL EDUCATION	EE	--			2	NIL
5	17APEE07	SPORTS AND GAMES (STATE AND NATIONAL LEVELS)	PHYSICAL EDUCATION	EE	--			3	NIL

(iii) EXTRA CURRICULAR COURSES (ECC)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17BMEE12	MASSIVE OPEN ONLINE COURSES (MOOCs) - I	BME	EE	0	0	4	2	NIL
2	17BMEE13	MASSIVE OPEN ONLINE COURSES (MOOCs) - II	BME	EE	0	0	4	2	NIL

17EGHS01	TECHNICAL ENGLISH	Category	L	T	P	Credit
		HSS	**3**	**0**	**0**	**3**

PREAMBLE

Technical English is a life skill course necessary for all students of Engineering and Technology. It aims at developing communication skills in English, essential for understanding and expressing the ideas of different professional context. The outcome of the course is to help the students acquire the language skills of Listening, Speaking, Reading and Writing competency in English language and thereby making the students competent and employable in the globalised scenario.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To enable students to develop LSRW skills in English. (Listening, Speaking, Reading, and Writing.)
2	To make them to become effective communicators
3	To ensure that learners use Electronic media materials for developing language
4	To aid the students with employability skills.
5	To motivate students continuously to use English language
6	To develop the students communication skills in formal and informal situations

COURSE OUTCOMES

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

CO1. Listen, remember and respond to others in different scenario	Remember
CO2. Understand and speak fluently and correctly with correct pronunciation in different situation.	Understand
CO3. To make the students experts in professional writing	Apply
CO4. . To make the students in proficient technical communicator	Apply
CO5. To make the students good communicators at the work place and to be theoretically strong.	Apply
CO6 To make the students recognize the role of technical writing in their careers in business, technical and scientific field	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	**M**	**M**			**M**	**M**	**S**		**L**	**S**	**L**	**S**	**S**		
CO2	**L**	**M**		**L**	**M**	**M**	**S**		**L**	**S**	**S**	**S**	**M**		**M**
CO3	**M**	**L**	**L**	**M**			**L**	**L**		**M**	**S**	**S**			**M**
CO4		**M**				**M**	**M**			**S**		**S**			**M**
CO5	**M**	**M**		**M**	**M**	**M**	**S**	**M**	**L**	**S**	**M**	**S**	**M**	**M**	**S**
CO6	**M**		**M**			**M**					**S**	**M**			**M**

S- Strong; M-Medium; L-Low

SYLLABUS

LISTENING

Self introduction - Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Interpretation of Images and Films - Identify the different Parts of Speech- Word formation with Prefixes and suffixes -Common Errors in English - Scientific Vocabulary (definition and meaning) - Listening Skills- Passive and Active listening, Listening to Native Speakers - Characteristics of a good listener.

SPEAKING

Articles - Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines -Listening to Indian speakers from different regions, intrusion of mother tongue - Homophones – Homonyms - Note taking and Note making - Difference between Spoken and Written English- Use of appropriate language - Listening and Responding to Video Lectures (Green India, environment, social talks) - Extempore.

REPORT WRITING

Tense forms- Verbal and Non verbal Communication - Describing objects - Process Description- Speaking Practice - Paragraph Writing on any given topic (My favourite place, games / Hobbies / School life, etc.) -Types of paragraphs - Telephone Etiquettes - Telephonic conversation with dialogue.

READING

Impersonal Passive Voice - Conditional Sentences - Technical and Non technical Report Writing (Attend a technical seminar and submit a report) - News Letters and Editing - Skimming- Scanning - How to Improve Reading Speed - Designing Invitations and Poster Preparation.

WRITING

Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding (Flow Chart, Bar Chart and Pie Chart) - Informal letters - Resume Writing- Difference between Bio data, Resume and Curriculum Vitae.

TEXT BOOK

1. English for Engineers- Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCE BOOKS

1. 1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and Cambridge University Press.

4 Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

Course Designers:

S.No.	Name of the Faculty	Mail ID
1.	Dr.P.Saradha / Associate Professor - English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor/Assistant Professor-English	Prem.english@avit.ac.in

17EGHS02	BUSINESS ENGLISH	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE

Language is one of the most valued possessions of men. It acts as a repository of wisdom. Among all other languages English, the international language plays a vital role as a propeller for the advancement of knowledge in different fields and as a telescope to view the dream of the future.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To impart and enhance corporate communication.
2	To enable learners to develop presentation skills
3	To build confidence in learners to use English in Business context
4	To make them experts in professional writing
5	To assist students understand the role of thinking in all forms of communication
6	To equip students with employability and job searching skills

COURSE OUTCOMES

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

CO1. Communicate with a range of formal and informal context	Understand
CO2. Students will undergo in activities, demonstrating interaction skills and consider how own communication is adjusted in different scenario	Apply
CO3. Strengthening of oral and written skills in the business context	Apply
CO4. Create interest among the students about a topic by exploring thoughts and ideas	Apply
CO5. Make the students to start with pleasing note and make them to give different ideas	Apply
CO6. Make them in better performance in the art of communication	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**M**		**L**		**L**	**S**	**S**		**M**	**S**		**S**	**S**		
CO2		**M**	**S**	**M**		**M**	**M**		**L**	**S**		**S**	**M**		**M**
CO3	**L**	**M**				**M**		**L**		**S**	**L**	**M**		**M**	**M**
CO4		**L**	**M**	**M**			**L**	**M**	**M**	**S**	**L**	**M**	**M**		
CO5				**M**				**M**	**L**	**S**		**L**			
CO6		**L**		**M**		**L**	**L**			**S**		**S**			

S- Strong; M-Medium; L-Low

SYLLABUS

SUBJECT AND VERB AGREEMENT: Subject and Verb Agreement (concord) - Preposition and Relative Pronoun - Cause and effect - Phrasal Verbs-Idioms and phrases-Listening Comprehension -Listening to Audio Files and Answering Questions-Framing Questions-Negotiation Skills-Presentation Skills and Debating Skills.

STRESS: Stress (Word Stress and Sentence Stress) Intonation- Difference between British and American English Vocabulary-Indianism-Compound Words (including Technical Terminology).

READING SKILL: Reading Skills-Understanding Ideas and making Inferences-Group Discussion-Types of Interviews – FAQs – E - Mail Netiquette - Sample E – mails - Watching Documentary Films and Responding to Questions.

CORPORATE COMMUNICATION: Corporate Communication -Recommendation-Instruction-Check List- Circulars-Inter Office Memo- Minutes of Meeting and Writing Agenda - Discourse Markers - Rearranging Jumbled Sentences - Technical Articles - Project Proposals-Making Presentations on given Topics -Preparing Power Point Presentations

CRITICAL READING: Critical Reading-Book Review-Finding Key Information and Shifting Facts from Opinions-Business Letters (Calling for Quotation, Placing Orders and Complaint Letters) - Expansion of an Idea-Creative Writing.

TEXTBOOK

1. English for Effective Communication - Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCE BOOKS

1. Grammar Builder – I, II, III – Cambridge University Press.
2. Technical English – Writing, Reading and Speaking – Pickett and Lester, Harper and Row

Course Designers:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor	Assistant Professor	English	Prem.english@avit.ac.in

17EGHS81	ENGLISH LANGUAGE LAB	Category	L	T	P	Credit
		HSS	0	0	4	2

PREAMBLE

English Language Laboratory provides technological support to students. It acts as a platform for learning, practicing and producing language skills through interactive lessons and communicative mode of teaching.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand communication nuisances in the corporate sector.
2	To understand the role of mother tongue in second language learning and to avoid interference of mother tongue.
3	To communicate effectively through different activities
4	To understand and apply the telephone etiquette
5	Case study to understand the practical aspects of communication
6	To improve the oral skills of the students

COURSE OUTCOMES

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

CO1. Give best performance in group discussion and interview	Understand
CO2. Best performance in the art of conversation and public speaking.	Apply
CO3. Give better job opportunities in corporate companies	Apply
CO4. Better understanding of nuances of English language through audio-visual experience and group activities	Apply
CO5. Speaking skills with clarity and confidence which in turn enhances their employability skills	Apply
CO6. Acquire strategic competence to use both spoken and written language in a wide range of communication strategies	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		S	M	S		L			S	S	M				M
CO2	M								M	S		M	M		M
CO3	M									S		M			M
CO4	M									M			M		M
CO5	M			S						M			M		S
CO6		M	M							M			M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE I: Ice Breaker, Grouping, Listening- (Hearing and listening)- Active Listening- Passive Listening – Listening to a song and understanding- (fill in the blanks) Telephone Conversation

MODULE II: Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to solve, Activity.

MODULE III: Why is English important, Communication skills, TED (video) Communication in different scenario – a case study, ingredients of success, Activity – chart, speak the design, feedback on progress, Group wise, Individual.

MODULE IV: Telephone Etiquette, Dining Etiquette, Meeting Etiquette.

MODULE V: Case study of Etiquette in different scenario.

Course Designers:

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1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
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17YMHS82	YOGA & MEDITATION	Category	L	T	P	Credit
		FC(HS)	0	0	4	2

PREAMBLE

Yoga is a physical, mental and spiritual practice or discipline which originated in ancient India and is followed in all over the world. Yoga is a discipline to improve or develop one's inherent power in a balanced manner. The University has been celebrating International Yoga day every year on 21st June. The University has developed Yoga to provide physical, mental and spiritual practices to the employees, students of the university.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand the fundamental concepts of yogic practices
2	To study the selected yogic practices and its impact on selected systems in the human body.
3	Learned the Principles of Practicing Asana, Pranayama and Meditation.

COURSE OUTCOMES

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

CO1. Understanding the purpose of learning of yogic practices.

CO2. Knowledge of the interconnections between the body, the breath, the mind and the emotions in the context of maintaining resilience and well-being

CO3. Understanding the principles of practicing asana, pranayama and meditation

CO4. Knowledge of health and disease relevant to the practice of the yoga therapy.

CO5. Creating awareness about international yoga day.

SYLLABUS

1. Starting Prayer.
2. Surya Namaskar.
3. Asanas-Padmasana,Vajrasana, Tadasana, Ardhakati chakrasana ,Uthana Padasana, Ustrasana,Makarasana,Paschimottanasana, Halasana, Savasana
4. Pranayama-Nadishuddhi,Kapalabhati,Sitkari, Sitali
5. Meditation-Deep Relaxation.
6. Mudra-Chin Mudra,Chinmaya Mudra.
7. Closing Prayer.

TEXTBOOKS

1. Iyengar B.K.S (2001), Yoga the path to holistic health, Dorling: Kindersley.
2. Mariayyah.P (2000) Suriyanamaskar, Perunthurai: Jaya Publishing House

REFERENCE BOOKS

1. Saraswati, Niranjanananda (2010) Prana and pranayama. Mungaer.
2. Iyengar B.K.S (2003), The art of yoga, New Delhi. Harper Collins publishers.

COURSE DESIGNERS

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1	Dr.G.S.Thangapandiyan	Assistant Professor	Physical Education	yogistp@gmail.com
2	Mr.N.Jayaraman	Assistant Professor	Physical Education	narayanajayaram82@gmail.com

17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	Category	L	T	P	Credit
		FC(HS)	3	0	0	3

PREAMBLE

A startup means company initiated by individual innovator or entrepreneurs to search for a repeatable and scalable business model. More specifically, a startup is a newly emerged business venture that aims to develop a viable business model to meet a marketplace needs or wants in an optimum manner.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand the basics of Startups Management and components.
2	To analyze the startups fund management practices
3	To practice the various kinds of stocks and employment considerations in startups.
4	To apply the importance of intellectual property rights and its procedures.
5	To explore the entrepreneurial mindset and culture.

COURSE OUTCOMES

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

CO1.Explain the concept of engineering startups, objectives and functions and its components.	Understand
CO2.Analyze the startups funding issues and remuneration practices in startups business.	Analyze
CO3.Analyze the various kinds of stocks and employment opportunities and consideration in startups business.	Analyze
CO4. Compare and contrast the various forms of intellectual property protection and practice.	Analyze
CO5.Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	M	M	S	--	M	--	M	--	M	M
CO2	S	S	M	M	M	L	--	--	--	--	--	M	L	M	M
CO3	S	S	S	M	M	M	--	--	--	--	--	M	L	M	S
CO4	S	S	S	M	M	M	--	--	--	--	--	M	M	M	S
CO5	S	S	--	M	M	M	--	--	--	--	--	M	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

Elements of a successful Start up: Create Management Team and Board of Directors – Evaluate market and Target Customers – Define your product or service –Write your Business Plan

Funding Issues and Remuneration Practices: Funding Issues: Investment Criteria – Looking for seed cash – Seed, Startup, and subsequent Funding Rounds – Milestone Funding - Remuneration Practices for your Start –up : Salaries – Headhunters – Equity Ownership – Form of Equity incentive vehicles – Other compensation – Employment Contracts

Stock Ownership & startup Employment Considerations: Stock ownership: Risk-Reward Scale – Ownership Interest over time – Common and preferred stock – Authorized and outstanding shares – Acquiring stock – Restricted Stock Grants – Future Tax Liability on Restricted Shares - Compensation and startup Employment Considerations : Entrepreneurs Need Insurance – Do Fringe benefits – outsourcing your benefits work – Life Insurance – Health Insurance – Disability Insurance

Protecting Intellectual Property: Protecting your intellectual property: Copyrights - patents–Trade secrets – Trademarks - The Legal Form of your Startup: Corporation – Partnership – Limited Liability Company – Sole Proprietorship - – Making the startup decision: commitment – Leaving a current employer - stay fit.

Entrepreneurship: Entrepreneurship - Introduction to Technology Entrepreneurship and Technology Ventures – Engineers as Entrepreneurs, The Mindset of the Entrepreneurial Leader, Creating and Selling the Entrepreneurial Value Proposition - Essentials of Successful Entrepreneurs – Social environment in entrepreneurial development – Economic environment in entrepreneurial development.

TEXT BOOKS:

1. James A. Swanson & Michael L. Baird, "Engineering your start-up: A Guie for theHigh-Tech Entrepreneur" 2nd ed, Professional Publications.inc
2. Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

REFERENCE BOOKS:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
3. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. Murugesan	Professor	Management Studies	murugesan@vmkvec.edu.in
2	Mr. T. Thangaraja	Assistant Professor	Management Studies	thangaraja@avit.ac.in

Subject Code	Subject Title	Category	L	T	P	Credit
17MABS01	**ENGINEERING MATHEMATICS**	BS	2	2	0	3

PREAMBLE

The driving force in Engineering Mathematics is the rapid growth of technology and is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

PREREQUISITE --

COURSE OBJECTIVES

1	To identify the characteristics of a linear system with Eigen values and Eigen vectors.
2	To improve their ability in solving geometrical applications of differential calculus
3	To find a maximum or minimum value for a function of several variables subject to a given constraint.
4	To understand the integration techniques for evaluating surface and volume integrals.
5	Incorporate the knowledge of vector calculus to support their concurrent and subsequent engineering studies

COURSE OUTCOMES

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

CO1. Able to understand the system of linear equations arising in all engineering fields using matrix methods.	Understand
CO2. Determine the evolute and envelope for a given family of curves	Apply
CO3. Apply differentiation to solve maxima and minima problems.	Apply
CO4. Compute the area and volume of plane using integration	Apply
CO5. Evaluate the surface and volume integral using Green's, Stokes and Gauss Divergence theorems	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO2	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO3	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO4	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO5	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

MATRICES: Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form.

DIFFERENTIAL CALCULUS: Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolute.

FUNCTIONS OF SEVERAL VARIABLES: Partial Derivatives – Total Differentiation – Maxima and Minima constrained Maxima and Minima by Lagrangian Multiplier Method.

MULTIPLE INTEGRALS: Double integration – change of order of integration – Cartesian and polar coordinates – Area as a double integral – Triple integration.

VECTOR CALCULUS: Directional derivatives – Gradient, Divergence and Curl – Irrotational and solenoidal – vector fields – vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorem (excluding proof).

TEXT BOOKS:

1. "Engineering Mathematics I & II", Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr.A.Singaravelu, "Engineering Mathematics I & II", 23rd Edition, Meenakshi Agency, Chennai (2016).

REFERENCES:

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill Education Pvt, New Delhi (2011).
2. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2012).
3. Kreyszig E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore (2012).
4. Kandasamy P, Thilagavathy K, and Gunavathy K., "Engineering Mathematics", Volumes I & II (10th Edition).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	Dr.G.Selvam	Asso.Prof	VMKVEC	selvam@vmkvec.edu.in
2	Ms.S.Gayathri	Asst.Prof.Grade I	AVIT	gayathri@avit.ac.in

Subject Code	Subject Title	Category	L	T	P	Credit
17MABS 06	**DIFFERENTIAL EQUATIONS AND TRANSFORMS**	BS	2	2	0	3

PREAMBLE

Ordinary Differential Equation is used in contrast with the term partial differential equation which may be with respect to more than one independent variable. A real time naturally available signal is in the form of time domain. However, the analysis of a signal is far more convenient in the frequency domain with the help of Transformations. Transform techniques are very important tool in the analysis of signals.

PREREQUISITE

Engineering Mathematics

COURSE OBJECTIVES

1	To learn ordinary differential equations with constant and variable coefficients
2	To learn Laplace transform and its Inverse method to solve differential Equations and integral transforms
3	To derive a Fourier series of a given periodic function by evaluating Fourier coefficients
4	To calculate the Fourier transform of periodic functions
5	To learn about Z- transforms and its applications

COURSE OUTCOMES

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

CO1. Solve differential equations with constant and variable coefficients and Simultaneous first order linear equations with constant coefficients	Apply
CO2. Use the Laplace Transform technique to solve ordinary differential equations.	Apply
CO3. To apply Fourier series methods to solve boundary value problems for linear ODEs.	Apply
CO4. To use the Fourier transform as the tool to connect the time domain and frequency domain in signal processing.	Apply
CO5. To gain the knowledge in Z Transform to the Analysis of Digital Filters and Discrete Signal.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M
CO2	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M
CO3	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M
CO4	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M
CO5	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

ORDINARY DIFFERENTIAL EQUATIONS: Solutions of second and third order linear ordinary differential equation with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

LAPLACE TRANSFORMS: Laplace transform – transform of elementary functions – basic properties – derivatives and integrals of transforms – transforms of derivatives and integrals – initial and final value theorems – Transform of periodic functions-Inverse Laplace transform – Convolution theorem – -Solution of linear ODE of second order with constant coefficients.

FOURIER SERIES: Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series - Parseval's identity - Harmonic Analysis.

FOURIER TRANSFORMS: Fourier transform pairs - Fourier Sine and Cosine transforms – Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

Z – TRANSFORMS: Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution Theorem – Formation of Difference Equations – Solution of first and second order Difference Equations using Z-Transform.

TEXT BOOKS:

1. Engineering mathematics I & II “, by Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr.A.Singaravelu, “Engineering Mathematics I & II”, 23rd Edition, Meenakshi Agency, Chennai (2016).
3. Dr.A.Singaravelu, “Transforms and Partial differential Equations", 18th Edition, Meenakshi Agency, Chennai (2013).

REFERENCES:

1. Grewal, B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi (2012).
2. Kreyszig, E., “Advanced Engineering Mathematics”, 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore (2012).
3. Veerarajan, T., “Engineering Mathematics I,II and III”, Tata McGraw Hill Publishing Co., New Delhi (2011).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	Dr. M.Vijayarakavan	Asso.Prof	VMKVEC	vijayarakavan@vmkvec.edu.in
2	Dr.A.K.Thamizhsudar	Asso.Prof. grade II	AVIT	thamizhsudar@avit.ac.in

17MABS12	STOCHASTIC PROCESSES AND NUMERICAL METHODS	Category	L	T	P	Credit
		BS	2	2	0	3

PREAMBLE

This course aims at developing the ability to deal with the characterization of various random processes and their properties, which forms the base for the study of signals and systems. It also provides necessary basic concepts of numerical methods for solving different kinds of problems occurring in engineering and technology.

PREREQUISITE

Engineering Mathematics(17MABS01)

COURSE OBJECTIVES

1	To be get exposed to finite differences and interpolation
2	Ability to find numerical solutions of differential equations
3	Formulate the fundamental probability distribution and density functions, as well as functions of random variables
4	Analyze continuous and discrete-time random processes
5	To get knowledge on spectral densities and apply the theory of stochastic processes to analyze linear systems

COURSE OUTCOMES

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

CO1. Apply methods to find intermediate numerical value & polynomial of Numerical data.	Apply
CO2. Solve the initial value problems using single step and multistep methods.	Apply
CO3. Apply the concepts of random variable, moments and moment generating function.	Apply
CO4. Classify the type of Random processes such as stationary, wide sense stationary and their properties.	Analyze
CO5 Experiment with various types of correlation and spectral densities of a function	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO2	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO3	S	S	S	S	M	--	--	--	--	--	--	M	S	M	M
CO4	S	S	S	S	M	--	--	--	--	--	--	M	S	M	M
CO5	S	S	S	S	M	--	--	--	--	--	--	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTERPOLATION AND APPROXIMATION: Interpolation with Newton's divided differences, Lagrange's polynomial, Newton forward and backward differences, central difference Formula (Stirling's and Bessel's).

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS: Single Step Methods - Taylor Series, Euler and Modified Euler, Runge-Kutta method of fourth order -first and second order differential equations. Multistep Methods - Milne and Adam's-Bash forth predictor and corrector methods.

RANDOMVARIABLES: Discrete and continuous random variables- Probability mass function – Probability density functions - moments, Moment generating functions and their properties.

STOCHASTIC PROCESSES: Classification, Stationary and Markov process, Binominal process, Poisson process, Sine-wave process, Ergodic processes.

CORRELATION FUNCTION AND SPECTRAL DENSITIES: Auto correlation for discrete and continuous process, Cross correlation functions - properties, Power spectral density, Cross spectral density – properties.

TEXT BOOKS:

1. Ross S.M., "Stochastic Processes", John Wiley & Sons, 3rd Edition, 2010.
2. Veerarajan.T, "Probability, Statistics and Random Processes", Tata McGraw Hill, 3rd Edition, 2008.
3. Jain M.K., Iyengar S.R.K and Jain R.K., "Numerical Methods for Engineering and Scientific Computation (Fourth Edition)", New Age International (P) Ltd., NewDelhi, 2010.

REFERENCES:

1. Gerald C.F., Wheatley P.O., "Applied Numerical Analysis" (Fifth Edition), Addison – Wesley, Singapore, 1998.
2. Trivedi K S, "Probability and Statistics with reliability, Queuing and Computer Science Applications", Prentice Hall of India, New Delhi, 2nd Edition, 2002.

COURSE DESIGNERS

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1	Dr.L.Tamilselvi	Professor	AVIT	ltamilselvi@avit.ac.in
2	Dr. S.Punitha	Asso.Prof.	VMKVEC	punitha@vmkvec.edu.in

17PCBS02	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS	Category	L	T	P	Credit
		CC	2	0	0	2

PREAMBLE

Engineering Physics is the study of advanced physics concepts and their applications in various technological and engineering domains. Understanding the concepts of laser, types of lasers, thepropagation of light through fibers, applications of optical fibers in communication and different types of non-destructive techniques will help an engineer to analyze, design and to fabricate various conceptual based devices.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser
2	To assess the applications of laser
3	To detail the principles of fiber optics
4	To study the applications of fiber optics
5	To explain various techniques used in Non-destructive testing

COURSE OUTCOMES

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

CO1. Understand the principles laser, fiber optics and non-destructive testing	Understand
CO2. Understand the construction of laser, fiber optic and Non-Destructive testing equipments	Understand
CO3. Demonstrate the working of laser, fiber optic and Non-Destructive testing based components and devices	Apply
CO4. Interpret the potential applications of laser, fiber optics and Non-Destructive testing in various fields.	Apply
CO5. Differentiate the working modes of various types of laser, fiber optic and Non-Destructive testing based devices.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		M									M	M		
CO2	S		L									M	M		
CO3	S			M			M					M	M		
CO4	S	M		M	M	S	M					M	S	M	
CO5	S	M	M									M	M		

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-I

LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO_2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram

UNIT-II

FIBRE OPTICS: Principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Applications: Fiber optic communication system – fiber optic displacement sensor and pressure sensor.

UNIT-III

NON-DESTRUCTIVE TESTING: Introduction – Types of NDT - Liquid penetrant method – characteristics of penetrant and developer - ultrasonic flaw detector – X-ray Radiography: displacement method – X-ray Fluoroscopy.

TEXT BOOK

1. Engineering Physics, compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.
2. P.K. Palanisamy, Engineering Physics, Scientific Publishers, 2011.
3. Dr.M. N. Avadhanulu, Engineering Physics, S.Chand & Co, 2010.

REFERENCE BOOKS

1. Beiser, Arthur, Concepts of Modern Physics, 5th Ed., McGraw-Hill, 2009.
2. Halliday.D, Resnick.R, Walker.J, Fundamentals of Physics, Wiley & sons, 2013.
3. Gaur R. K. and Gupta S. L., Engineering Physics, DhanpatRai publishers, New Delhi, 2001.
4. Avadhanulu.M.N., Arun Murthy.T.V.S, Engineering Physics Vol. I, S.Chand, 2014.
5. Rajendran. V, Engineering Physics, Tata McGraw Hill Publication and Co., New Delhi, 2009.
6. Baldev Raj et al. Practical Non-Destructive Testing, Narosa Publications, 2017.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
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17PCBS02	**PHYSICAL SCIENCES PART B -ENGINEERING CHEMISTRY Semester I (Common to All Branches)**	Category	L	T	P	C
		BS	2	0	0	2

Preamble

Objective of this course is to present a better understanding of basic concepts of chemistry and its applications on different engineering domains. It also imparts knowledge on fundamentals of Electrochemistry, Energy storage technologies, properties of water and its treatment methods, classification of fuels, Non conventional sources of Energy and various advanced Engineering materials.

Prerequisite

Not required

Course Objectives

1	To impart basic knowledge in Chemistry so that the student will understand the engineering concept
2	To familiar with electrochemistry and Battery and fuel Cells
3	To lay foundation for practical applications of water softening methods and its treatment methods in engineering aspects.
4	To inculcate the knowledge of fuels and advanced material.

Course Outcomes

After the successful completion of the course, learner will be able to

CO1.	Describe the electrochemistry, batteries and working principle of energy storage devices	Understand
CO2.	Estimate the hardness of water	Apply
CO3.	Identify suitable water treatment methods	Analyze
CO4.	Outline the important features of fuels and advanced materials	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1.	S	M	-	M	-	S	S	S	-	-	L	M	M	-	-
CO2.	S	S	M	-	-	M	M	M	-	-	-	M	-	-	M
CO3.	S	S	M	-	-	M	S	M	-	-	-	M	-	-	M
CO4.	S	-	-	-	L	L	M	L	-	-	-	S	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

Electrochemistry, Batteries and Fuel cells
Electrode potential - Nernst equation – Electrodes (SHE, Calomel and Glass) - cells - EMF measurement. Primary battery (Daniel and dry cell) – secondary battery (lead Acid storage battery and Nickel-Cadmium battery) – Fuel cell (H_2-O_2 fuel cell)
Water Technology and Corrosion
Sources of water – impurities – Hardness and its determination (problems to be avoided) – boiler troubles – water softening (Zeolite & Demineralisation) – Domestic water treatment – Desalination (Electrodialysis & Reverse Osmosis).
Fuels And Chemistry of Advanced Materials
Classification of Fuels (Solid, Liquid, Gaseous, Nuclear and Bio fuels) – Calorific Value of a fuel –Non Petroleum Fuels –Non conventional sources of Energy – combustion. Basics and Applications:-Organic electronic material, shape memory alloys, polymers (PVC, Teflon, Bakelite)

TEXT BOOKS

1. Engineering Chemistry by prepared by Vinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

1. A text book of Engineering Chemistry by S.S. Dara, S.Chand & company Ltd., New Delhi
2. Engineering Chemistry by Jain & Jain, 15^{th} edition Dhanpatrai Publishing Company (P) Ltd., New Delhi
3. A text book of Engineering Chemistry by Shashi Chawla, Edition 2012 Dhanpatrai & Co., New Delhi.
4. Engineering Chemistry by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com
2.	Mr. A. Gilbert Sunderraj	Assistant Professor	Chemistry	asmgill80@gmail.com
3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
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17PHBS05	SMART MATERIALS	Category	L	T	P	Credit
		Basic Sciences	3	0	0	3

PREAMBLE

Smart Materials gives an outlook about various types of materials having potential application in Engineering and Technology. In particular, Students learn about Smart Materials and their applications, Properties of Crystalline Materials & Nanomaterials, Characteristics of Magnetic materials. They also get a clear picture about superconducting materials.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To explain the fundamental properties and classification of smart materials, crystalline materials, Nano materials, Magnetic materials and Super conducting materials.
2	To paraphrase the basic crystalline structure and its properties.
3	To illustrate the synthesis and fabrication of Nano materials.
4	To predict the application of smart materials, crystalline materials, Nano materials, Magnetic materials and Super conducting materials.
5	To analyze the various parameters of crystalline materials.

COURSE OUTCOMES

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

CO1. Restate the properties of various materials.	Understand
CO2. Summarize the various structures of materials.	Understand
CO3. Predict the applications of various materials to designing equipments.	Apply
CO4. Illustrate the properties of materials to designing equipments.	Apply
CO5. Calculate the crystalline parameters of the materials.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	S				M			S			
CO2	S	M	S	M	S				M			M			
CO3	S	S	S	S	S				S			M	S	M	M
CO4	S	M	S	M	S				M			M	S	M	M
CO5	M	S	S	M	M				S			M			

S- Strong; M-Medium; L-Low

SYLLABUS

SMART MATERIALS: Shape Memory Alloys (SMA) – Characteristics and properties of SMA, Application, advantages and disadvantages of SMA. Metallic glasses – Preparation, properties and applications.

CRYSTALLINE MATERIALS: Unit cell – Bravais lattice – Miller indices – Calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures.

NANO MATERIALS: Nanophase materials – Top-down approach - Mechanical Grinding - Lithography - Bottom-up approach – Sol-gel method – Carbon nanotubes – Fabrication – applications.

MAGNETIC MATERIALS: Basic concepts – Classification of magnetic materials – Domain theory – Hysteresis – Soft and Hard magnetic materials.

SUPERCONDUCTING MATERIALS: Superconducting phenomena – properties of superconductors – Meissner effect – isotope effect – Type I and Type II superconductors – High Tc Superconductors – Applications of superconductors.

TEXT BOOK:

Mani P, Engineering Physics II, Dhanam Publications, 2018.

REFERENCES:

1. Pillai S.O., Solid State Physics, New Age International (P) Ltd., publishers, 2018.

2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2018.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. MOHAMMED HARSHULKHAN	Asst.Prof	Physics	harshulkhan@vmkvec.edu.in
2	Mr. R. SAKTHI GANAPATHY	Asst.Prof	Physics	sakthiganapthy@vmkvec.edu.in
3	Dr .G. LATHA	Professor	Physics	latha.physics@avit.ac.in
4	Dr. R. N. VISWANATH	Professor	Physics	viswanath.physics@avit.ac.in

17PCBS81	PHYSICAL SCIENCES LAB: PART A – REAL AND VIRTUAL LAB IN PHYSICS	Category	L	T	P	Credit
		CC	0	0	2	1

PREAMBLE

In this laboratory, experiments are based on the calculation of physical parameters like young’s modulus, rigidity modulus, viscosity of water, wavelength of spectral lines, thermal conductivity and band gap. Some of the experiments involve the determination of the dimension of objects like the size of a microparticle and thickness of a thin wire. In addition to the above real lab experiments, students gain hands-on experience in virtual laboratory.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To impart basic skills in taking reading with precision of physics experiments
2	To inculcate the habit of handling equipments appropriately
3	To gain the knowledge of practicing experiments through virtual laboratory.
4	To know the importance of units
5	To obtain results with accuracy

COURSE OUTCOMES

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

CO1. Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO2. Operate the equipments with precision	Apply
CO3. Practice to handle the equipments in a systematic manner	Apply
CO4. Demonstrate the experiments through virtual laboratory	Apply
CO5. Calculate the result with accuracy	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S													
CO2	S	S	M	M	S				M			M	M	M	
CO3	S														
CO4	S	S	M	M	S							S	M	M	
CO5	S	S													

S- Strong; M-Medium; L-Low

SYLLABUS

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser

6. Wavelength of spectral lines – grating – Spectrometer
7. Thickness of a wire - Air wedge Method
8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box
10. Specific resistance of a wire – Potentiometer

LAB MANUAL

Physical Sciences Lab: Part A – Real And Virtual Lab In Physics Manual compiled by Department of Physics, Vinayaka Missions Research Foundation (Deemed to be University), Salem.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in
3	Dr. G. SURESH	ASSOCIATE PROFESSSOR	PHYSICS	suresh.physics@avit.ac.in
4	Dr. B.DHANALAKSHMI	ASSOCIATE PROFESSSOR	PHYSICS	dhanalakshmi.phy@avit.ac.in

17PCBS81	**PHYSICAL SCIENCES PART B - ENGINEERING CHEMISTRY LAB Semester I (Common to All Branches)**	Category	L	T	P	C
		BS	0	0	2	1

Preamble

The main objective of this course is to develop the intellectual and psychomotor skills of the students by imparting knowledge in water technology and quantitative analysis.

Prerequisite

Not required

Course Objectives

1	To impart basic skills in Chemistry so that the student will understand the engineering concept.
2	To inculcate the knowledge of water and electrochemistry.
3	To lay foundation for practical applications of chemistry in engineering aspects.

Course Outcomes

After the successful completion of the course, learner will be able to

CO1.	Estimate the chemical properties of water	Apply
CO2.	Determine the presence of various elements in the water	Analyze
CO3.	Calculate the strength of acids, oxidizing and reducing agents	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	S	M	M	-	L	M	M	S	-	-	-	M	-	S	M
CO2.	S	M	M	-	L	M	M	L	-	-	-	M	M	S	M
CO3.	S	S	M	-	L	M	M	M	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Determination of Hardness by EDTA method
2. Estimation of Hydrochloric acid by conductometric method
3. Acid Base titration by pH method
4. Estimation of Ferrous ion by Potentiometric method
5. Determination of Dissolved oxygen by Winkler's method
6. Estimation of Sodium by Flame photometer
7. Estimation of Copper from Copper Ore Solution
8. Estimation of Iron by Spectrophotometer

TEXT BOOKS

1. Laboratory Manual on Engineering Chemistry prepared by Vinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

1. Laboratory Manual on Engineering Chemistry, K. Bhasin S, Dhanpat Rai Publishing Co Pvt Ltd

Course Designers:

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1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com
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3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
4.	Dr.K.Sanghamitra	Associate Professor	Chemistry	sanghamitra.chemistry@avit.ac.in

17CHBS01	**Environmental Science & Engineering (Common to All Branches)**	Category	L	T	P	C
		BS	3	0	0	3

Preamble

Environmental science and Engineering is an interdisciplinary field that integrates physical, chemical, biological, information sciences and provides the basic knowledge of structure and function of ecosystem and better understanding of natural resources, biodiversity and their conservation practices. The course helps to create a concern for our environment that will generate pro-environmental action, including activities we can do in our daily life to protect it. Furthermore, it deals the social issues and ethics to develop quality engineer in our country.

Prerequisite

Not required

Course Objectives

1	Applying Science and Engineering knowledge to protect environment
2	To provide comprehensive insight in natural resources and protect natural resources
3	To create awareness on the various pollutions and their impact.
4	To educate the ways and means to manage natural calamities
5	To impart fundamental knowledge on human welfare measures

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Comprehend the impact of engineering solutions in a global and societal context	Understand
CO2.	Illustrate the contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems	Understand
CO3.	Illustrate the importance of ecosystem and biodiversity	Apply
CO4.	Practice to improve the environment and sustainablity	Apply
CO5.	Conclude the importance of conservation of resources.	Analyze
CO6.	Estimate the important role of IT in healthy environment for future generations	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1.	S	M	-	-	-	M	S	S	M	M	-	S	M	M	S
CO2.	S	-	-	-	-	S	S	S	-	-	-	S	M	M	S
CO3.	S	-	-	-	-	M	S	M	L	-	-	S	-	M	-

CO4.	S	-	-	-	-	M	S	S	M	M	-	S	M	M	S
CO5.	S	-	-	-	-	M	S	S	M	M	-	S	-	M	M
CO6.	S	-	-	-	-	M	S	S	M	M	-	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

ENVIRONMENT AND NATURAL RESOURCES
Environment - Definition, scope & importance - Public awareness- Forest resources, mineral resources , water resources, food resources , energy resources (uses, over -exploitation & adverse effects in each case) - Scope & role of environmental engineers in conservation of natural resources - Sustainability development.
ECOSYSTEMS AND BIO – DIVERSITY
Ecosystem - Definition, structure and function - Energy flow -Ecological succession - food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest, grassland, desert and Aquatic ecosystems - Bio - Diversity :values and uses, hotspots, threats and conservation.
ENVIRONMENTAL POLLUTION
Pollution - Definition, man made impacts and control measures of air, water and land pollution - Water quality standards & characterization - Importance of sanitation -Nuclear hazards – Hazardous waste management : Solid waste, waste water and biomedical waste - Prevention of pollution and role of individual – Disasters management : Floods, earthquake, cyclone and land slides - Clean technology options.
SOCIAL ISSUES AND ENVIRONMENT
Urban problems related to energy - Water conservation – Resettlement and rehabilitation of people - Environmental ethics - Climate change - Global warming - Acid rain - Ozone depletion-Waste land reclamation, Environment Protection Act for air, water, wild life and forests - Pollution Control Board.
HUMAN POPULATION AND ENVIRONMENT
Population growth - Population explosion - Family welfare programme - Environment & human health - Human rights – Value education - Women and child welfare, Role of information technology in environment and human health.
TEXTBOOK
1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.
REFERENCES

1. Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.
2. Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3. Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines, Compliances and tandards Vol I & II, Enviro media.
4. Dr. J. Meenambal, Environmental Science and Engineering, MJP Publication, Chennai
5. Gilbert M. Masters : Introduction to Environmental Engineering and Science, Pearson Education Pvt Ltd., II Edition, ISBN 81-297-0277-0, 2004

Course Designers:

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3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
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17PHBS04	MEDICAL PHYSICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Medical physics is the application of physics concepts, theories and methods in medicine or healthcare. Medical physics finds application in the following healthcare specialties: diagnostic and interventional radiology, nuclear medicine and radiation protection. Understanding the concepts of atomic physics, radiation and their interaction with cells, will help the biomedical engineer in designing medical equipments.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To recall the basic principles and properties of atomic and nuclear physics.
2	To explain the interaction of radiation with cells.
3	To examine the somatic effects of radiation.
4	To correlate the genetic effects of radiation.
5	To outline the applications of physics in medicine.

COURSE OUTCOMES

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

CO1. Discuss the basic principles of atoms, nuclear radiations and laser	Understand
CO2. Explain the properties of atoms, nuclear radiations and laser	Understand
CO3. Interpret the characteristics of artificially produced isotopes, interaction of radiation with cells, biological effects of laser	Apply
CO4. Illustrate the somatic effects of radiation, genetic effects of radiation, laser safety management	Apply
CO5. Analyze the decay series, chromosomal damage, penetration and propagation of signal effects in various vital organs	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S			M		M						M	M	M	
CO2	S			M		M						M	M	M	
CO3	S	M	M	M	M	M						M	S	M	
CO4	S	S	M	M	M	M						M	S	M	
CO5	S	S	M	M	M	M						M	M	M	

S- Strong; M-Medium; L-Low

SYLLABUS

ATOMIC PHYSICS: Traditional definition of atom, periodic system of elements, mechanical properties of atom, emission of light and its frequencies. Electromagnetic spectra. Principles of Nuclear Physics – Natural radioactivity, Decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles.

INTERACTION WITH LIVING CELLS: Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, depression of Macro molecular synthesis, Chromosomal damage.

SOMATIC EFFECT OF RADIATION: Radio sensitivity protocol of different tissues in human, LD 50/30 effect of radiation on skin, blood forming organs, lenses of eye, embryo and Endocrinal glands.

GENETIC EFFECT OF RADIATION: Threshold of linear dose effect, factors affecting frequency of radiation induced mutation, Gene controlled hereditary diseases, biological effect of microwave and RF wave. Penetration and propagation of signals effects in various vital organs, Protection standards.

PHOTO MEDICINE: Synthesis of Vitamin D in early and late cutaneous effects, Phototherapy, Photo hemotherapy. LASER PHYSICS – Characteristics of Laser radiation, Laser speckle, biological effects, laser safety management.

TEXT BOOK:

1. Herman Cember, Introduction of Health physics, Thomas E Johnson, McGraw Hill, 2008.

REFERENCES:

1. Eric J. Hall, Amato J.Giaccia, Radiology for the Radiologist, 7th Edition, Wolters Kluver, 2012.
2. Branski. S and Cherski. P, Biological effects of Microwave, Hutchinson & ROSS Inc., Strondsburg, 1980.
3. Moselly, Non ionising Radiation, Adam Hilgar, Brustol, 1988.

COURSE DESIGNERS

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17CSES01	ESSENTIALS OF COMPUTING	Category	L	T	P	Credit
		ES	3	0	0	3

PREAMBLE
This course aims to provide the fundamental concepts of Computer operations like hardware and software installation, and emphasizing principles application packages. Studying the fundamentals concepts of Algorithms, to resolve the real world application.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To provide basic knowledge of hardware and software components of computers.
2	To introduce and demonstrate various software application packages.
3	To study Problem solving Techniques and program development cycle.
4	To learn about various algorithm and identifying the algorithm efficiency.
5	To learn different algorithm for various application.

COURSE OUTCOMES

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

CO1. To understand the Basic knowledge on hardware and software terminologies.	Understand
CO2. To Demonstrate the various Application Packages like MS-word, MS- Excel etc.	Apply
CO3.To Understand Program Devolvement Cycle and apply various Problem Solving Techniques.	Apply
CO4.To analyze the efficiency of Algorithms.	Analyze
CO5.To Implement of Algorithms for various concepts.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	M	M	-	M	-	-	-	-	-	-	M	M	-	-
CO3	S	S	S	-	M	-	-	-	-	-	-	-	-	-	-
CO4	S	S	S	-	S	-	-	-	-	-	-	-	-	-	-
CO5	S	M	M	-	M	-	-	-	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF COMPUTER AND INFORMATION TECHNOLOGY: Computer – Generations, Types of Computers, Block diagram of a computer – Components of a computer system –Hardware and software definitions – Categories of software – Booting – Installing and Uninstalling a Software –Software piracy – Software terminologies – Applications of Computer – Role of Information Technology – History of Internet – Internet Services.

SOFTWARE APPLICATIONS: Office Automation: Application Packages – Word processing (MS Word) – Spread sheet (MS Excel) – Presentation (MS PowerPoint).

PROBLEM SOLVING METHODOLOGIES: Problems Solving Techniques - Program Development Cycle – Algorithm Development – Flow chart generation –Programming Constructs (Sequential, Decision-Making, Iteration) – Types and generation of programming Languages.

INTRODUCTION TO ALGORITHMS: Implementation of Algorithms – program verification – The efficiency of algorithms – The analysis of algorithms.

IMPLEMENTATION OF ALGORITHMS: Fundamental Algorithms: Introduction – Exchanging the values of two variables – Counting – Summation of a set of Numbers – factorial computation – Generation of the Fibonacci sequence – Reversing the digits of an integer.

TEXT BOOKS:

1. "Essentials of Computer Science and Engineering", Department of Computer Sciences, VMKVEC, Salem, Anuradha Publishers, 2017.
2. Dromey.R.G, "How to Solve it by Computer", Prentice-Hall of India, 1996.

REFERENCES:

1. Aho.A.V., Hopcroft.J.E and Ullman.J.D, "The Design and Analysis of Computer Algorithms", Pearson Education, 2004.
2. Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd Edition, Addison Wesley, 1997.

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17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING A. BASIC ELECTRICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	2	0	0	2

PREAMBLE

It is a preliminary course which highlights the basic concepts and outline of Electrical engineering. The concepts discussed herein are projected to deliver explanation on basic electrical engineering for beginners of all engineering graduates.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To understand the electrical inventions, basic concepts of AC and DC circuits and basic laws of electrical engineering.
2	To gain knowledge about the working principle, construction, application of DC and AC machines and measuring instruments.
3	To understand the fundamentals of safety procedures, Earthing and Power system.

COURSE OUTCOMES

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

CO1: Explain the evolution of electricity, name of the inventors, electrical quantities and basic laws of electrical engineering.	Remember
CO2: Demonstrate Ohm's and Faraday's Law.	Apply
CO3:Understand the basic concepts of measuring instruments, electrical machineries and its applications.	Understand
CO4: Analyze the various types of electrical loads, power rating of electrical machineries and energy efficient equipment.	Analyze
CO5: Explain the electrical safety and protective devices.	Understand
CO6: Compare the various types electrical power generation systems by application of conventional and non-conventional sources.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	S	--	--	--	--	--	--	L	M	L	--
CO2	S	M	S	S	--	--	--	--	M	-	--	M	M	L	--
CO3	L	S	L	--	S	--	--	--	--	L	--	L	M	L	--
CO4	S	M	S	L	L	S	S	--	--	S	--	L	M	L	--
CO5	L	M	S	M	--	S	M	M	--	S	--	L	M	L	M
CO6	S	L	S	L	M	S	S	--	--	M	--	L	L	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

HISTORY OF ELECTRICITY, QUANTITIES AND CIRCUITS

Evolution of Electricity and Electrical inventions, Electrical quantities- Charge, Electric potential, voltage, current– DC & AC, power, energy, time period, frequency, phase, flux, flux density, RMS, Average, Peak, phasor & vector diagram. Electric Circuits - Passive components (RLC), Ohm's law, KCL, KVL, Faraday's law, Lenz's law. Electrical materials – Conducting and insulating materials.

MEASURING INSTRUMENT AND ENERGY CALCULATION

Measuring Instruments – Analog and Digital meters – Types and usage. AC and DC Machines & Equipment- Types, Specifications and applications.

Loads – Types of Loads- Power rating and Energy calculation – for a domesticload. Energy Efficient equipments – star ratings.

ELECTRICALSAFETY AND INTRODUCTIONTOPOWERSYSTEM

Protection & Safety - Hazards of electricity - shock, burns, arc-blast, Thermal Radiation, explosions, fires, effects of electricity on the human body. Electrical safety practices, Protection devices.

Electric Power- Generation resources, Transmission types & Distribution system (levels of voltage, power ratings and statistics)- Simple layout of generation, transmission and distribution of power.

TEXT BOOKS:

1. Metha.V.K,RohitMetha,“BasicElectricalEngineering”,Fifth Edition,Chand.S&Co,2012.
2. Kothari.D.PandNagrath.I.J,“BasicElectricalEngineering”,Second Edition,TataMcGraw-Hill,2009.
3. R.K.Rajput , “Basic Electrical and Electronics Engineering”, Second Edition, Laxmi Publication, 2012.
4. P. Selvam, R. Devarajan, A.Nagappan, T. Muthumanickam and T. Sheela“Basic Electrical and Electronics Engineering”, First Edition, VMRFDU, Anuradha Agencies, 2017

REFERENCE BOOKS:

1. SmarajtGhosh, “FundamentalsofElectrical&ElectronicsEngineering”,SecondEdition,PHILearning,2007.

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17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING B. BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC(ES)	2	0	0	2

PREAMBLE

The course aims to impart fundamental knowledge on electronics components, digital logics and communication engineering concepts. The course begins with classification of various active and passive components, diodes and transistors. It enables the student to design small digital logics like multiplexer, demultiplexer, encoder, decoder circuits, etc. It crafts the students to get expertise in modern communication systems.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To learn and identify various active and passive components and their working principles.
2	To understand the number conversion systems.
3	To learn the digital logic principles and realize adders, multiplexer, etc.,
4	To understand the application oriented concepts in the communication systems.

COURSE OUTCOMES

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

CO1. Interpret working principle and application of various active and passive electronic components like resistors, capacitors, inductors, diodes and transistors.	Understand
CO2. Construct the rectifiers and regulators circuits and explore their operations.	Apply
CO3. Execute number system conversions and compute several digital logic operations.	Apply
CO4. Design adders, Multiplexer, De-Multiplexer, Encoder, Decoder circuits.	Apply
CO5. Apply the modern technologies in developing application oriented gadgets like the UHD, OLED, HDR.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	--	--	--	--	--	--	M	--	--	--	-	-	-
CO2	S	M	M	M	--	--	M	--	M	--	--	M	-	M	-
CO3	S	M	M	--	--	--	--	--	M	--	--	--	S	-	-
CO4	S	M	M	M	--	--	M	--	M	--	--	M	S	M	-
CO5	S	M	--	--	M	--	M	--	M	M	--	M	-	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

SEMICONDUCTOR DEVICES

Passive and Active Components - Resistors, Inductors, Capacitors, Characteristics of PN Junction Diode - Zener Diode and its Characteristics - Half wave and Full wave Rectifiers - Voltage Regulation. Bipolar Junction Transistor, JFET, MOSFET & UJT.

DIGITAL FUNDAMENTALS
Number Systems – Binary, Octal, Decimal and Hexa-Decimal – Conversion from one to another – Logic Gates – AND, OR, NOT, XOR, Universal Gates – Adders, Multiplexer, De Multiplexer, Encoder, Decoder – Memories

COMMUNICATION AND ADVANCED GADGETS
Modulation and Demodulation – AM, FM, PM – RADAR – Satellite Communication – Mobile Communication, LED, HD, UHD, OLED, HDR & Beyond, Smart Phones – Block diagrams Only.

TEXT BOOKS:

1. R.K. Rajput, "Basic Electrical and Electronics Engineering", Laxmi Publications, Second Edition, 2012.
2. Dr.P.Selvam, Dr.R.Devarajan, Dr.A.Nagappan, Dr.T.Muthumanickam and Dr.T.Sheela,"Basic Electrical and Electronics Engineering", Department of EEE & ECE, Faculty of Engineering & Technology, VMRFDU, Anuradha Agencies, 2018.
3. Edward Hughes, "Electrical and Electronics Technology", Pearson Education Limited, Ninth Edition, 2005.

REFERENCES:

1. John Kennedy, "Electronics Communication System", Tata McGraw Hill, 2003.

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17CSES05	PROGRAMMING IN PYTHON	CATEGORY	L	T	P	CREDIT
		ES	3	0	0	3

PREAMBLE

The purpose of this course is to introduce Python, a remarkably powerful dynamic programming language to write code for different operating systems along with application domain. Python has evolved on more popular and powerful open source programming tool

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To provide basic knowledge on Python programming concepts.
2	To introduce different methods in list, string, tuple, dictionary and sets.
3	To compute different programs using python control statements.
4	To learn about different functions in python.
5	To compute the exception handling functions, file concepts and CSV and JSON.

COURSE OUTCOMES

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

CO1. Learn python statements, comments and indentation, tokens, input and output methods using various example programs.	Understand
CO2. Apply the different methods involved in List, String, Tuples and Dictionary.	Apply
CO3. Design solutions for complex programs using decision making and looping statements.	Apply.
CO4.Apply the function programs with all the concepts like lambda, decorators and generators.	Apply.
CO5. Compute the exception handling programs, file concept programs and understand the concepts of CSV and JSON.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	M	M	-	-	-	-	-	-	-	M	-	-
CO3	M	S	S	S	M	-	-	-	-	-	-	-	M	-	-
CO4	S	S	S	S	M	-	-	-	-	-	-	-	M	-	-
CO5	S	M	M	M	M	-	-	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-1 INTRODUCTION

Introduction to python-Advantages of python programming-Tokens-Variables-Input/output methods-Data types-Operators

UNIT-2 DATA STRUCTURES

Strings-Lists-Tuples-Dictionaries-Sets

UNIT-3 CONTROL STATEMENTS

Flow Control-Selection control Structure-if-if-else-if-elif-else-Nested if iterative control structures-while loop, for loop and range.

UNIT-4 FUNCTIONS

Declaration-Types of Arguments-Fixed arguments, variable arguments, keyword arguments and keyword variable arguments-Recursions-Anonymous functions: lambda- Decorators and Generators.

UNIT-5 EXCEPTION HANDLING

Exception Handling-Regular Expression-Calendars and clock files:File input/output operations-Dictionary operations-Reading and writing in structured files:CSV and JSON.

TEXT BOOKS:

1. Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.
2. Programming With Python Book ‘Himalaya Publishing House Pvt Ltd
3. “Dive Into Python” by Mark Pilgrim

REFERENCES:

1. Mark Lutz, “Learning Python”, 6th Edition, O'Reilly Media, 2014.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2015.
3. Mark Lutz, “Python Pocket Reference”, 6th Edition, O'Reilly Media, 2015.

COURSE DESIGNERS

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17CSES83	PROGRAMMING IN PYTHON LAB	Category	L	T	P	Credit
		ES	0	0	4	2

PREAMBLE

This laboratory enables the students clearly understand the basic concepts of python, control statements and file commands in python.

PRERQUISITE

NIL

COURSE OUTCOMES

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

CO1. Learn Syntax and Semantics and create Functions in Python	Understand
CO2. Handle Strings and Files in Python.	Understand
CO3. Design solutions for complex programs using decision making and looping statements.	Apply
CO4.Understand Lists, Dictionaries in Python.	Apply
CO5. Compute the exception handling programs	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO4	S	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO5	S	M	M	-	-	-	-	-	-	--	-	-	-	M	M

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Write a program to sum of series of N natural numbers
2. Write a program to calculate simple interest.
3. Write a program to generate Fibonacci series using for loop
4. Write a program to calculate factorial using while loop
5. Write a program to find the greatest of three numbers using if condition
6. Write a program for finding the roots of a given quadratic equation using conditional control statements
7. Write a program to find the greatest of three numbers using conditional operator
8. Write a program to compute matrix multiplication using the concept of arrays
9. Write a program to implement recursive function
10. Write a program to read and write data using file concepts

REFERENCES:

1. Mark Lutz, “Learning Python”, 5th Edition, O'Reilly Media, 2013.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2013.
3. Mark Lutz, “Python Pocket Reference”, 5th Edition, O'Reilly Media, 2014.

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17EEES82	ENGINEERING SKILLS PRACTICE LAB A. BASIC ELECTRICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	0	0	2	1

PREAMBLE

It is a laboratory course which familiarizes the basic electrical wiring, measurement of electrical quantities and various types of earthing methods.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To learn the residential wiring and various types of electrical wiring.
2	To measure the various electrical quantities.
3	To know the necessity and types of earthing and measurement of earth resistance.

COURSE OUTCOMES

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

CO 1: Implement the various types of electrical wiring.	Apply
CO 2: Measure the fundamental parameters of AC circuits.	Analyze
CO 3: Measure the earth resistance of various electrical machineries.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	S	--	--	--	--	--	--	L	M	L	--
CO2	S	M	S	S	--	--	--	--	M	--	--	M	M	L	--
CO3	L	S	L	--	S	--	--	--	--	L	--	L	M	L	--

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

REFERENCES

1. Laboratory Reference Manual.

COURSE DESIGNERS

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17EEES82	ENGINEERING SKILLS PRACTICES LAB PART B - BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC(ES)	0	0	2	1

PREAMBLE

This course is to provide a practical knowledge in Basic Electronics Engineering. It starts with familiarization of electronic components and electronic equipments. It enables the students to construct and test simple electronic projects.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To familiarize the electronic components, basic electronic equipments and soldering techniques.
2	To study the characteristics of Diodes, BJT and FET.
3	To understand the principles of various digital logic gates.
4	To understand the concept of basic modulation techniques.

COURSE OUTCOMES

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

CO1. Construct experiments for PN and Zener diode characteristics	Understand
CO2. Demonstrate the fundamentals of soldering techniques.	Apply
CO3. Classify the characteristics of Diodes, BJT and FET.	Apply
CO4. Distinguish between amplitude and frequency modulation techniques.	Apply
CO5. Verify the truth tables of logic gates (AND, OR, NOT, NAND, NOR, XOR).	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	M	-	M	-	-	-	-
CO2	M	M	M	-	-	-	-	-	M	-	M	-	-	-	-
CO3	S	M	-	-	-	-	-	-	M	-	M	-	S	M	-
CO4	S	M	-	-	-	-	-	-	M	-	M	-	M	-	M
CO5	S	M	M	-	-	-	-	-	M	-	M	-	M	-	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Identifying Electronics Components.
2. Practicing of Soldering and Desoldering.
3. Characteristics of PN junction Diode.
4. Characteristics of Zener diode.
5. Input & Output characteristics of BJT.
6. Transfer characteristics of JFET.

7. Verification of Logic Gates.
8. Study of Amplitude Modulation.
9. Study of Frequency Modulation.

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17CSES07	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING	Category	L	T	P	Credit
		FC(ES)	3	0	0	3

PREAMBLE
The aim is to introduce the concept of storage of data using list, stack and queue.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To comprehend the fundamentals of object oriented programming, particularly in C++.
2	To use object oriented programming to implement data structures.
3	To introduce linear, non-linear data structures and their applications.
4	To study about shorting and searching.
5	To learn and implement the concepts of templates and exception handling.

COURSE OUTCOMES

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

CO1. Able to learn about tree structures and tree traversals.	Understand
CO2. Discuss about the balanced trees.	Understand
CO3. Explain about the hashing and sets.	Understand
CO4. Develop object-oriented applications that can handle exceptions.	Apply
CO5. Construct object-oriented applications for a given scenario to persist data using files and object-serialization.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	-	-	-	M	M	-	-	L	S	-	M
CO2	S	M	M	-	-	-	-	M	M	-	-	L	S	-	M
CO3	S	M	M	-	M	-	-	M	M	M	M	L	S	M	-
CO4	S	M	M	-	M	-	-	M	M	M	M	L	S	M	M
CO5	S	M	M	-	M	-	-	M	M	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS
DATA ABSTRACTION & OVERLOADING
Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables –Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function –Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator

Overloading.

INHERITANCE & POLYMORPHISM

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

LINEAR DATA STRUCTURES

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation – singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT – Evaluating arithmetic expressions.

NON-LINEAR DATA STRUCTURES

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components.

SORTING AND SEARCHING

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search.

TEXT BOOKS:

1. Deitel and Deitel, **"C++, How to Program"**, 5th Edition, Pearson Education, 2005.
2. Mark Allen Weiss, **"Data Structures and Algorithm Analysis in C++"**, 3rd Edition, Addison Wesley, 2007.

REFERENCES:

1. Bhushan Trivedi, **"Programming with ANSI C++, A Step-By-Step approach"**, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, **"Data Structures and Algorithms in C++"**, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, **"Introduction to Algorithms"**, 2nd Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, **"The C++ Programming Language"**, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, **"Fundamentals of Data Structures in C++"**, Galgotia Publications, 2007.

COURSE DESIGNERS

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1	Dr. R. Jaichandran	Associate Professor	CSE	jaichandran@avit.ac.in
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17CSES86	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING LAB	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

PREAMBLE

To teach the principles of good programming practice and to give a practical training in writing efficient programs in C++

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To teach the students to write programs in C++
2	To implement the various data structures as Abstract Data Types
3	To write programs to solve problems using the ADTs

COURSE OUTCOMES

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

CO1. Design and implement C++ programs for manipulating stacks, queues, linked lists, trees, and graphs.	Create
CO2. Apply good programming design methods for program development.	Apply
CO3. Apply the different data structures for implementing solutions to practical problems.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	M	M	-	-	M	M	M	S	S	M	-
CO2	S	M	M	-	-	M	-	-	M	M	M	S	S	M	M
CO3	S	S	S	S	M	M	-	-	M	M	M	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

<u>List of Experiments</u>

1. Exercises using Objects, Classes, Inheritance, Operator Overloading and Polymorphism.
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list and Array implementations of Stack ADT
4. Queue ADT
5. Quick Sort
6. Design C++ classes with static members, methods with default arguments, friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix-vector multiplication)
7. Implement complex number class with necessary operator over loadings
8. Overload the new and delete operators to provide custom dynamic allocation of memory.
9. Develop a template of linked-list class and its methods.
10. Develop templates of standard sorting algorithms such as merge sort.

TEXT BOOKS: Department Lab Manual				
COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
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17EEES04	ELECTRIC MACHINERY	Category	L	T	P	Credit
		FC(ES)	3	0	0	3

Preamble

In a modern world the electrical motors plays a vital role in all the applications especially in bio medical field its employed in various medical and health care equipments such as patient handling equipment, compressors, respirators, pacemakers, defibrillators , exercisers, wheelchairs, massage apparatus, therapy equipment, etc. Hence the course provides the knowledge about basic concepts with performance analysis of DC, AC and special electrical machines under different load and unloaded condition as well as the knowledge required for implementation of the above machines in biomedical field.

PREREQUISITE

17EEES03 - Basics of Electrical & Electronics Engineering A. Basic Electrical Engineering

COURSE OBJECTIVES

1	To study the importance of electrical machines in bio medical field and to understand the principle concepts of electro mechanical energy conversion.
2	To understand the concepts of transformer to determine the performance of the device through the equivalent circuit and working principle.
3	To illustrate the construction, operating principle and types of DC machines with its starting and speed control methods.
4	To elucidate the construction, working principle of Synchronous & Induction machine with conventional starting and speed control methods.
5	To describe the construction and principle operation of special electrical machines such as BLDC motor, PMBLDC motor, linear motor and universal motor etc.

COURSE OUTCOMES

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

CO1. Define and understand the concept of electromechanical energy conversion process and easy to implement the concepts to biomedical applications.	Remember
CO2. Identify the parts of transformer, explain the concept and predetermine the performance of the transformer.	Understand
CO3. Categorize the parts of DC machine, describe the concepts of DC machine and analyze the Performance at different loading, un loading conditions and applications.	Analyze
CO4. Implement the concepts of Induction and Synchronous machines to various applications to determine the performance.	Apply
CO5. Choose the suitable special electrical machine and evaluate the performance of the device for biomedical applications.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	--	--	--	--	M	--	--	--	M	S	S
CO2	M	S	--	--	--	--	--	--	M	--	--	--	S	M	M
CO3	S	S	--	--	--	--	--	--	M	--	--	--	M	M	--
CO4	S	S	--	M	--	--	--	--	M	--	--	--	M	M	--
CO5	S	M	L	M	--	--	--	--	M	--	--	M	S	M	--

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Need of electrical machines in Bio medical field – Typical applications and requirements of biomedical motors-Electrical Machines – Classification – Basic and Electromagnetic induction Principle – statically induced EMF, Dynamically induced EMF and back EMF – principles of electromechanical energy conversion –Forces and torque - Energy and co energy – Single and Multiple excited systems.

TRANSFORMER

Principle of operation of transformer – Types – Constructional features – EMF equation – Phasor diagram on No Load and Load – Equivalent circuit, Losses and Efficiency of transformer and regulation – OC and SC tests – Predetermination of efficiency and regulation – Autotransformer – Applications.

DC MACHINES

Construction and principle operation of DC machines – EMF equation – Types of DC machines – DC generators – Magnetization and load characteristics of DC generators, DC Motors – Characteristics of DC motors – Armature reaction – Commutation – Voltage and Torque equation - Starting methods of DC machines – Losses and efficiency – Speed control of DC shunt motor –Applications.

INDUCTION MACHINES AND SYNCHRONOUS MACHINES

Construction and Principle of operation of Induction machines – Types - Double revolving field theory – Equivalent circuit of induction machines – Starting methods of induction machines –Speed control of induction machines – Principle of operation of synchronous motor – Different Excitations of synchronous motor – Starting methods – Equivalent circuit- Applications.

SPECIAL ELECTRIC MACHINES

Switched reluctance motor, Stepper motor, Servo motor, BLDC motor, Permanent magnet BLDC motor- Permanent magnet synchronous motor – Universal motor – Hysteresis motor – Linear induction motor – Working principles, Speed-Torque characteristics – Applications.

TEXT BOOKS:

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 3rd Edition, 2010.
2. B. L. Theraja, A. K. Theraja, “A Text Book of Electrical Technology”, Volume II, S.Chand & Company Ltd, New Delhi, 2016.

REFERENCES:

1. Stephen J. Chapman, “Electric Machinery fundamentals”, McGraw Hill Education, New Delhi, 5th Edition, 2011.
2. Fitzgerald A.E, Charles Kingsley Jr, Stephen D. Umans, “Electric Machinery”, Mc Graw Hill Book Company, 6th Edition, 2005.
3. T. Kenjo and S.Nagomari, “Permanent magnet and brushless DC motors”, Clarendon 125 Press, London, 1985.

COURSE DESIGNERS

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1	Mr.G.Ramakrishnaprabu	Associate Professor	EEE	ramakrishnaprabu@vmkvec.edu.in
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3	Dr.G.Ezhilarasan	Professor	EEE	ezhilarasan.eee@avit.ac.in

17ECCC01	SEMICONDUCTOR DEVICES	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course is designed to teach the physical principles and operational characteristics of semiconductor devices with emphasis on metal-oxide systems, bipolar, high-electron mobility, and field-effect transistors. Topics also include SCR, TFET, HEMT, Silicon Nano Wire tubes. The course provides advanced background in solid state electronic devices and is intended to help students to develop their basic analytical skills and continue advanced research in the varied branches of semiconductor devices.

PRERQUISITE NIL

COURSE OBJECTIVES

1	To emphasis the physics of semiconductors and the working of semiconductor devices like PN and Zener diodes with their applications.
2	To impart knowledge on working principle, configuration, operational characteristics and limitation of BJTs.
3	To understand the construction and Characteristics of JFETs and MOSFETs.
4	To study the working principle and applications of discrete and integrated voltage regulators
5	To familiarize with several special semiconductor devices like SCR, MISFET, TFET, HEMT and Silicon Nano Wire tubes.

COURSE OUTCOMES

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

CO1. Explain the electron transport properties and operation of semiconductor devices like Diode and their relevant applications like HWR, FWR, Clipper and Clamper, etc.,	Understand
CO2. Quantify the specification and characteristics of BJT in different configuration.	Apply
CO3. Demonstrate RMS and ripple factor values of RC filters in simple power supply and voltage regulators circuits	Apply
CO4. Relate the construction and characteristics of JFET and its families.	Apply
CO5. Examine the characteristics and applications of special devices like Shockley Diode, Unijunction Transistor, Phototransistors, MISFETs, MESFETs, etc.,	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	-	-	-	-	-	-	M	-	-	M	-	-	-
CO2	M	M	M	-	-	-	-	-	M	-	-	M	-	-	-
CO3	M	M	M	-	-	-	M	-	M	-	-	M	M	M	M
CO4	S	M	M	M	-	-	M	-	M	-	-	M	M	M	-
CO5	S	M	-	M	-	-	-	-	M	-	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

SEMICONDUCTOR DIODES AND APPLICATIONS

Introduction, Semiconductor Materials - Ge, Si, and GaAs, Covalent Bonding and Intrinsic Materials, Energy Levels, n-Type and p-Type Materials, Semiconductor Diode, Resistance Levels, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Diode Specification Sheets, Semiconductor Diode Notation, Diode Testing, Zener Diodes, Light-Emitting Diodes, Sinusoidal Inputs; Half-Wave Rectifier, Full-Wave Rectifier, Clipper, Clamper, Zener Diode, Voltage-Multiplier Circuits, Practical Applications

BIPOLAR JUNCTION TRANSISTORS

Introduction, Transistor Construction, Transistor Operation, Common-Base Configuration, Common-Emitter Configuration, Common-Collector Configuration, Limits of Operation, Transistor Specification Sheet, Transistor Testing, Transistor Casing and Terminal Identification.\

FIELD EFFECT TRANSISTORS

Introduction, Construction and Characteristics of JFETs, Transfer Characteristics, Important Relationships, Depletion-Type MOSFET, Enhancement-Type MOSFET, MOSFET Handling.

VOLTAGE REGULATORS

Introduction, General Filter Considerations, Capacitor Filter, RC Filter, Discrete Transistor Voltage Regulation, IC Voltage Regulators.

SPECIAL PURPOSE DEVICES

Introduction, Silicon-Controlled Rectifier, Basic Silicon-Controlled Rectifier Operation, SCR Characteristics and Applications, Shockley Diode, Diac, Triac, Unijunction Transistor, Phototransistors, MISFETs, MESFETs, TFETs, HEMTs, Silicon Nano Wire Transistor.

TEXT BOOK:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education, 11th Edition, 2013.

REFERENCE BOOKS:

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, “Electron Devices and Circuits”, Tata McGraw Hill, 2010.
2. David A Bell, “Fundamentals of Electronic Devices and Circuits”, Oxford Press, 2009.
3. B L Theraja, R S Sedha, “Principles of Electronic Devices and Circuits”, S.Chand, 2004.

COURSE DESIGNERS

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1.	Dr.P.Selvam	Professor	ECE	hodeee@vmkvec.edu.in
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17BTCC01	ESSENTIALS OF BIOCHEMISTRY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Essentials of biochemistry deals with the study of biomolecules found in living organism. The course exposes the students to classification, properties, basic structure and functions of biomolecules like carbohydrate, amino acid, lipids, nucleic acid and vitamins. Knowledge of this course will enable students to understand the importance of biomolecules and give awareness to the various diseases associated with the deficiency of biomolecules.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To understand the basic structure and properties of carbohydrate, lipids, amino acids and nucleic acids.
2	To emphasize the functional importance and role of biomolecules in living orgaisms.
3	To illustrate the nutritional importance of Minerals.
4	To illustrate the nutritional importance of Vitamins and its deficiency diseases.

COURSE OUTCOMES

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

CO1. Recall the classification, properties and structure of carbohydrates, lipids, amino acids and protein.	Remember
CO2. Discuss the biological importance of biomolecules and its nutritional value.	Understand
CO3. Identify about the structures of amino acids, proteins and Nucleic acids.	Understand
CO4. Correlate the vitamins and its deficiency diseases.	Apply
CO5. Illustrate the minerals and its deficiency diseases.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO02	PSO3
CO1	M	-	L	-	-	-	-	-	-	-	-	-	M	M	-
CO2	M	-	M	-	-	-	-	-	-	-	-	-	-	M	-
CO3	M	-	M	-	-	-	-	-	-	-	-	-	-	M	-
CO4	S	L	M	S	-	L	-	-	-	-	-	L	-	-	M
CO5	S	L	M	S	-	M	-	-	-	-	-	L	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

CARBOHYDRATE

Biological importance, Classification and Properties of Monosaccharides, Disaccharides and Polysaccharides (Starch, Glycogen, Cellulose and their derivatives, Chitin, Peptidoglycans, Glycoaminoglycans, Glycoconjugates).

LIPIDS

Biological importance, Classification. Fattyacids: classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, Triacylglycerols: nomenclature, physical properties, chemical properties. Glycerophospholipids (lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, sphingomyelins).

AMINO ACIDS AND PROTEINS

Amino acids – Classification, Structure, Properties and Biological importance. Proteins – Classification, Structural organization of Proteins – Primary, Secondary (α-helix, β-pleated structure, triple helix), Tertiary and Quaternary (Myoglobin and Hemoglobin), Factors stabilizing, Properties and Biological importance, Denaturation and Renaturation.

NUCLEIC ACIDS

Nucleosides and nucleotides, configuration and conformation, Composition of RNA and DNA, Physico-chemical properties of nucleic acids – effect of alkali, acid and heat (denaturation and renaturation), features of phosphodiester bond, endonucleases. Complementary base pairing, secondary structure of RNA, features of DNA double helix (Watson-Crick model), Nucleoproteins – histone and nonhistone

VITAMINS

Nutritional importance of vitamin, classification, source, daily requirements and functions, Deficiency symptoms – hypervitaminosis of fat soluble vitamins. Nutritional importance of Minerals – classification, source, daily requirement and deficiency symptoms.

TEXT BOOKS

1. “Fundamentals of Biochemistry”, Jain J.L., Sunjay Jain and Nitin Jain., S.Chand& Company Ltd., 6th Edition, 2005.

REFERENCES:

1. “Text Book of Biochemistry for Medical Students”, AmbikaShanmugham, Lippincott Williams & Wilkins, 7th Edition, 2012.
2. “Biochemistry”, Rastogi S.C. Mc. Graw-Hill Publishing Company Ltd, 6th Edition, 2007.
3. “Principles of Biochemistry”, David L. Nelson and Michael M. Cox, W. H. Freeman and Company, 4th Edition, 2005.
4. “Text book of Biochemistry”, Sathyanarayana U and Chakrapani U., Uppala Author Publishers Interlinks, 3rd Edition, 2006.

COURSE DESIGNERS

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17BMCC01	BIOMEDICAL CIRCUITS & NETWORKS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The field of engineering, such as electrical, electronics, communications, biomedical and instrumentation, are based on electric circuits and networks. An electrical network is an interconnection of electrical elements (Active and Passive) such as resistors, inductors, capacitors, transformers, diodes, sources, controlled sources and switches. One of the main objectives of a biomedical engineer is to acquire the knowledge about electric circuits, analyse and synthesize electric networks that improve the realization of electric networks and devices for a given biomedical application.

PREREQUISITE

17EEES03 - Basics of Electrical & Electronics Engineering

COURSE OBJECTIVES

1	To Express the basic methods of circuit analysis using Mesh & Nodal Analysis.
2	To describe the various Network theorem and apply them in biomedical circuits.
3	To get an insight into solution of RLC circuits, resonance as well as Analysis of coupled circuits.
4	To explain the concept of complex frequency and Total responses of RL, RC & RLC circuits two Port network parameters.
5	To Analyse the stability & Synthesis of Network and understand about the filter design.

COURSE OUTCOMES

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

CO1.	Discuss the circuit‘s behavior using Ohm‘s law and Kirchhoff‘s laws.	Understand
CO2.	Express the source transformations, mesh analysis, nodal analysis and network theorems to understand the circuit behavior.	Understand
CO3.	Illustrate the series, parallel resonance and magnetically coupled circuits behavior hence apply the concepts in biomedical field.	Apply
CO4.	Relate the AC circuits using phasor techniques under steady state and transient condition for dc and sinusoidal excitation and dramatize the two-port parameters of networks.	Apply
CO5.	Use the synthesis of network and able to initiate the concept of filters and design a filter for various range of frequencies.	Apply
CO6.	Perform circuit analysis to prove circuit laws and theorems independently.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	M	--	--	--	--	--	--	M	L	L	L
CO2	S	M	L	L	M	--	--	--	M	--	--	M	M	L	L
CO3	M	M	L	L	L	M	--	M	--	--	--	--	S	L	L
CO4	S	M	L	L	L	--	--	--	--	--	--	--	S	M	L
CO5	M	M	L	L	L	M	--	M	--	--	--	--	S	M	L
CO6	M	M	M	S	S	--	--	--	M	--	--	--	S	S	L

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF CIRCUIT ANALYSIS

Circuit Laws, DC and AC excitation, series and parallel circuits, voltage division and current division Mesh current and Node Voltage method of Analysis, Matrix method of Analysis. Source Transformation Technique, Wheatstone bridge. Analyzing simple biomedical circuits by simulation. **Applications:** Resistive Sensors, Resistive Temperature Detector (RTD).

NETWORK THEOREMS

Star-Delta Transformation, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Compensation Theorem, Reciprocity theorem, Duals and Duality, Analyzing theorems by simulation**.** **Applications:** Electro Surgery Unit (ESU).

AC CIRCUITS & COUPLED CIRCUITS

Power & Power factor, Series resonance-Q factor, Bandwidth, Parallel resonance-Q factor, Bandwidth, Mutual Inductance – Coefficient of coupling, dot rule, Analysis: Single-tuned, and Double-tuned circuits. **Applications:** Human Vocal cord and speech generation.

TRANSIENT ANALYSIS

Source free and forced responses of RL, RC, and RLC circuits with DC and Sinusoidal excitation. **Applications:** Prosthetic Limb device, Strain relaxation of a muscle fiber. **TWO PORT NETWORKS** – Impedance, admittance, Hybrid and Transmission parameter, Inter relation and interconnection of networks.

NETWORK SYNTHESIS & FILTER DESIGN

Causality and Stability analysis of network functions, Hurwitz polynomial, Positive Real Functions and Cauer Foster forms. **Applications:** Impedance Spectroscopy.

Filter Design: Filter networks – Constant K filters, m derived filters, composite filters. Butterworth and Chebyshev approximation.

TEXT BOOKS:

1. Hayt, Kemmerley & Durbin, **"Engineering circuit Analysis"**, Tata McGraw Hill, 8th Edition 2012.
2. Sudhakar.A and Shyammohan.S P, **"Circuits and Networks - Analysis and Synthesis"**, Tata McGraw Hill, 4th Edition 2014.
3. Ali Ümit Keskin, **"Electrical Circuits in Biomedical Engineering, Problems with Solutions"**, © Springer International Publishing AG 2017.

REFERENCES:

1. Franklin F. Kuo, **"Network Analysis and Synthesis"**, John Wiley & Sons, 2nd Edition Reprint 2009.
2. Mahmood Nahvi & Joseph Edminister, **"Schaum's Outline of Electric circuits"**, McGraw-Hill Education, 5th Edition 2011.
3. Umesh Sinha, **"Network Analysis and Synthesis"**, Satyaprakashan Publishers, 2013.
4. Aatre V.K, **"Network Theory and Filter Design"**, New Age International Publishers, 2nd Edition Reprint 2003.

COURSE DESIGNERS

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1	Mr.S.Mathankumar	Associate Professor	BME	mathankumar@vmkvec.edu.in
2	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in
3	Mr.R.Pathamuth	Assistant Professor (Gr-II)	BME	pathamuthu@avit.ac.in

17BMCC02	HUMAN ANATOMY AND PHYSIOLOGY	Category	L	T	P	Credit
		CC	4	0	0	4

PREAMBLE

Anatomy is the science of body structures and the relationships among them. The science of physiology is concerned with the function of the body. The prime concern of this syllabus is to integrate the individual functions of all the cells and tissues and organs into functional whole, the human body. Since function is dependent on a structure, the curriculum lays stress on functional anatomy of the organs. Understanding the organs, their structures and correlating it with their physiology leads to a truly holistic approach which can help the biomedical engineer to understand and design various medical equipment.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To recall the basic terminologies, cells, tissues and organs of human body.
2	To explain the basic elements and structure of the major organ systems.
3	To illustrate the functions of various organ system.
4	To outline the relationship between the various organ system.
5	To outline the role of hormones and various sense organs.

COURSE OUTCOMES

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

CO1.	Define the basic terminologies and identify the different cells, tissues and organs.	Remember
CO2.	Describe the gross and microscopic anatomy of major organ system.	Understand
CO3.	Illustrate the relationship and interaction between the various organ systems.	Apply
CO4.	Outline the physiology of cardiovascular, respiratory, nervous, musculoskeletal, digestive, excretory and other organ systems.	Analyze
CO5.	Analyze the functions of hormones with physiological process and physiology of vision, hearing, smell and taste.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	--	--	--	--	--	--	M	--	--	L	--	M	--
CO2	M	L	--	--	--	--	--	--	M	--	--	L	--	M	M
CO3	S	S	M	--	--	S	--	--	S	--	--	S	S	S	S
CO4	S	S	M	--	--	S	--	--	S	--	--	S	S	S	S
CO5	S	S	M	--	--	S	--	--	S	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC ELEMENTS OF HUMAN BODY: Anatomical terms of Location, Position and Planes. Structure and functions of Cell and organelles. Tissues of the human body: epithelial, connective, muscular and nervous tissues. Overview of organ systems. Membrane - Transport across membrane, Origin of cell membrane potential, Action potential. Blood - Properties and functions, Cellular Components: RBC, WBC, platelets, Blood Groups.

CARDIOVASCULAR AND RESPIRATORY SYSTEMS: Structure of heart, Blood vessels, Conduction system of heart, Physiology of Cardiac Muscle, Cardiac cycle, Heart Sound, Cardiac output – Coronary and Peripheral Circulation, Blood pressure and its regulation. Respiratory Organs, Mechanism of respiration, Carbon dioxide and oxygen transport, Regulation of respiration, Volumes and capacities of lung.

NERVOUS SYSTEM AND MUSCULOSKELETAL SYSTEM: Neurons, Synapse and neurotransmitters, Central nervous system: Structure and functions of brain, Meninges, ventricles of brain and cerebrospinal fluid, Spinal cord anatomy. Peripheral nervous system: Classification of peripheral nervous system, Autonomic nervous system, Reflex action. Muscular System: Classification of muscles, Anatomy and Physiology of skeletal muscle. Bone: Types, Functions, Anatomy of long bone – Formation, growth and repair, Structural and functional classification of joints.

DIGESTIVE AND EXCRETORY SYSTEM: Anatomy of the gastro-intestinal tract, Accessory organs of Digestion - Salivary glands, Liver, Pancreas, Gall Bladder. Movement of gastrointestinal tract, Digestion and absorption at various parts of the system, Defecation. Anatomy of Urinary System, Physiology of urine formation, physiology of micturition, Composition of Urine. Skin and Sweat Gland – Temperature regulation.

SPECIAL ORGANS AND ENDOCRINE GLANDS: Anatomy of Eye and Physiology of Vision, Structure of Ear and Physiology of Hearing, Sense of Smell, Sense of Taste. **Endocrine system:** Structure and functions of Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas, Pineal gland, Thymus, Ovaries and Testes.

TEXT BOOKS:

1. Arthur C. Guyton, John E. Hall, **"Textbook of Medical Physiology"**, W.B. Saunders Company, Twelfth Edition, 2006.
2. Ranganathan, T.S. **"Text Book of Human Anatomy"**, S.Chand & Co. Ltd., Delhi, 1996.

REFERENCES:

1. Ross & Wilson, **"Anatomy & Physiology for Health and Illness"**, Elsevier, 11th Edition, 2010.
2. Stuart I. Fox, **"Human Physiology"**, Tata McGraw Hill, 9th Edition, 2006.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.K.Natarajan	Associate Professor	BME	natarajank@vmkvec.edu.in
2	Ms.S.Mythrehi	Assistant Professor (G-I)	BME	mythrehi@avit.ac.in

17BMCC03	BIOSENSORS AND TRANSDUCERS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course is designed to make the student acquire conceptual knowledge of the transducers and biological components used for the detection of an analyte. The relation between sensor concepts and biological concepts is highlighted. The principles of biosensors that are currently deployed in the clinical side are introduced.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To use the basic concepts of transducers, electrodes and its classification.
2	To discuss the various types of electrodes.
3	To determine the recording of biological components.
4	To employ the knowledge in electrochemical and optical biosensors.
5	To outline the various biological components using biosensors.

COURSE OUTCOMES

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

CO1. Describe the working principles of transducers.	Understand
CO2. Explain the various types of electrodes.	Understand
CO3. Utilize various FET sensors for recording of biological components.	Apply
CO4. Distinguish various biosensors like electrochemical and optical biosensors.	Analyze
CO5. Analyze the biological components using biosensors in various applications.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO2	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO3	S	M	L	S	--	S	M	M	M	--	--	M	M	M	M
CO4	S	S	L	S	--	S	M	M	S	--	--	M	S	M	M
CO5	S	S	L	S	--	S	M	M	S	--	--	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: General measurement system, Transducers and its classification, Resistance transducers, capacitive transducer, Inductive transducer.

TRANSDUCERS:
Temperature transducers, piezoelectric transducers, Piezo resistive transducers, photoelectric transducers.

BIO POTENTIAL ELECTRODES:
Half cell potential, Types of Electrodes –Micro electrodes, Depth and needle electrodes, Surface electrodes, Chemical electrodes, Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

BIOSENSORS:
Biological elements, Immobilization of biological components, Chemical Biosensor-ISFET, IMFET, electrochemical sensor, chemical fibro sensors.

APPLICATIONS OF BIOSENSORS:
Bananatrode, blood glucose sensors, non invasive blood gas monitoring, UREASE biosensor, Fermentation process control, Environmental monitoring, Medical applications.

TEXT BOOKS:

1. H.S. Kalsi, **"Electronic Instrumentation & Measurement"**, Tata McGraw HILL, 1995.
2. Brain R Eggins, **"Biosensors: An Introduction",** John Wiley Publication, 1997.
3. Shakthi chatterjee, **"Biomedical Instrumentation"**, Cengage Learning, 2013.
4. John G Webster, **"Medical Instrumentation: Application and design"**, John Wiley Publications, 2001.

REFERENCES:

1. K.Sawhney, **"A course in Electronic Measurements and Instruments"**, Dhapat Rai & sons, 1991.
2. John P Bentley, **"Principles of Measurement Systems"**, 3rd Edition, Pearson Education Asia, (2000 Indian reprint).
3. Geddes and Baker, **"Principles of Applied Biomedical Instrumentation"**, 3rd Edition, John Wiley Publications, 2008.

COURSE DESIGNERS

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17ECCC02	ANALOG CIRCUITS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Analog circuits enables the students to have an insight knowledge on fundamentals of various electronic circuits. The designed course makes the students to work on the various applications of the electronic devices. This subject helps the students to design, model and develop rectifier circuits, amplifier circuits, oscillator circuits and many other real time application circuits

PREREQUISITE

17ECCC01 - Semiconductor Devices

COURSE OBJECTIVES

1	To understand the small signal BJT/FET Models.
2	Identify the frequency response of BJT and FET.
3	Apply the basic concept and working of various types of feedback amplifiers and oscillators.
4	To understand the working different types of large signal amplifiers and tuned amplifiers.
5	To learn about various compound configurations of multivibrators.

COURSE OUTCOMES

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

CO1. Illustrate the small signal models of BJT/FET amplifiers.	Apply
CO2. Design an amplifier for a given frequency response.	Apply
CO3. Construct different oscillators, multivibrators & compound configurations and feedback amplifier circuits.	Apply
CO4. Design oscillator circuits by using simulation tools.	Apply
CO5. Analyze various parameters of feedback amplifier (voltage series, voltage shunt, current series and current shunt) by using simulation tools.	Analyze
CO6. Analyze the efficiency of large signal amplifiers and bandwidth of tuned amplifier by using simulation tools.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	M	-	-	-	-	-	-	M	M	-	-
CO2	S	S	S	M	M	-	-	-	-	-	-	M	M	M	-
CO3	S	S	S	M	M	-	-	-	-	-	-	M	-	-	-
CO4	S	S	S	M	M	-	-	-	-	-	-	M	M	M	-
CO5	S	S	S	S	M	-	-	-	-	-	-	M	S	M	M
C06	S	S	S	S	M	-	-	-	-	-	-	M	S	M	M
S- Strong; M-Medium; L-Low															

SYLLABUS

BIASING CIRCUITS AND SMALL SIGNAL MODELS

Biasing circuits: DC load line and bias point – BJT biasing circuits – FET biasing circuits. Small-signal models: AC load line, Two port devices and hybrid Model, Analysis of transistor amplifier circuits using hparameters, Hybrid-π CE transistor model.

BJT AND JFET FREQUENCY RESPONSE

BJT amplifiers: CE, CB and CC amplifiers, FET amplifiers: CS, CG and CD amplifiers –designing BJT & FET amplifier networks Frequency response: low frequency response of BJT with RL, Low frequency response of FET amplifiers – Miller effect capacitance – high frequency response of BJT and FET amplifiers, Multistage frequency effect.

FEEDBACK AMPLIFIERS AND OSCILLATOR CIRCUITS

Classification of Amplifiers, Feedback Concepts, Effect of Negative Feedbacks, Voltage Series Feedback , Current Series Feedback, Voltage Shunt Feedback and Current Shunt Feedback , Oscillator basics, Types of Oscillators-RC oscillator, LC Oscillator and Crystal Oscillator.

LARGE SIGNAL AMPLIFIERS AND TUNED AMPLIFIERS

Class A Large Signal amplifier, Second Order Distortion, Push –Pull Amplifier, Class B, Class AB amplifiers, Class C amplifiers, Tuned amplifiers– single tuned – double tuned – synchronously tuned amplifiers –Real Time Applications of amplifiers.

COMPOUND CONFIGURATIONS AND MULTIVIBRATORS

Introduction, Cascade Connection, Cascode Connection, Darlington Connection, Differential Amplifier Circuit, CMRR, Schmitt Trigger.

TEXT BOOKS:

1. Jacob Millman, Christos C Halkias, Satyabrata Jit,"Electron Devices and Circuits", Tata McGraw Hill, 4TH Edition, 2015.

2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Edition, 2013.

REFERENCE BOOKS:

1. Adel S Sedra,Kenneth C Smith,"Microelectronic Devices",,Oxford University Press,7th Edition,2015.

2. David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, 5th Edition,2008.

3. Jacob Millman, Christos C Halkias, Chetan D Parikh ,"Integrated Electronics", Tata McGraw Hill, 2nd Edition, 2010.

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17ECCC05	DIGITAL LOGIC CIRCUITS & DESIGN	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

One of the most important reasons for the unprecedented growth of Digital Electronics and systems is the advent of integrated circuits(ICs).Developments in the IC technology have made it possible to fabricate complex digital circuits such as microprocessors, memories and FPGAs etc. This course provides various methods and techniques suitable for a variety of digital system design applications.

PREREQUISITE

17EEES03 - Basics of Electrical and Electronics Engineering

COURSE OBJECTIVES

1	To understand the various number systems and their conversions.
2	To learn the Boolean expressions, Boolean postulates and Karnaugh map method to reduce the variables.
3	To impart the design knowledge of various combinational logic circuits and sequential circuits.
4	To understand the basics of hardware descriptive language.
5	To design the RTL for various logic circuits.

COURSE OUTCOMES

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

CO1. Explain the basic principles of digital system, Logic gates and Boolean laws.	Understand
CO2. Simplify Boolean expression using K-Map techniques.	Apply
CO3. Examine various Combinational circuits using logic gates.	Apply
CO4. Illustrate the operation of sequential circuits using Flip flops	Analyze
CO5.Analyze various digital circuits using HDL programming.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS O2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	L	-	-	-
CO3	S	S	M	M	M	-	-	-	-	-	-	L	S	-	M
CO4	S	S	M	M	M	-	-	-	-	-	-	L	S	M	M
CO5	S	S	M	M	M	-	-	-	-	-	L	L	S	M	M
S- Strong; M-Medium; L-Low															

SYLLABUS

Basics of digital system:

About Digital system, Analog versus Digital, Advantages of processing information in digital form, Number System-Binary,Octal,Decimal & Hexadecimal Number Systems & its Conversion, Complement Arithmetic, Signed Binary Numbers, Binary Codes, Binary Storage And Registers.

Boolean Algebra, Logic Gates & Gate –Level Minimization:

Introduction, Boolean Algebra, basic theorem & properties of Boolean Algebra, Boolean functions, canonical & standard forms, logical operations, logic gates, Integrated circuits, Map method-upto four variable K-maps, Product of Sums (POS) & Sum of Products (SOP) simplification, don't care conditions, NAND & NOR implementations, Exclusive-OR Function, Hardware Description Language(HDL).

Combinational logic:

Introduction, Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder, Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Code Converters, Encoders, Decoders, Multiplexers.

Synchronous Sequential Logic, Register & Counters:

Sequential circuits, storage elements: latches, flip flops, Analysis of clocked sequential circuits, Moore and Mealy circuits ,state diagram, state reduction & Assignment, design procedure, shift registers, ripple counters, synchronous counters.

Design At The Register Transfer Level:

Register Transfer Level Notation, Register Transfer Level In HDL, ASM, Sequential Binary Multiplier, Control Logic, HDL Description Of Binary Multiplier, Design With Multiplexers, Race Free Design, Latch Free Design.

TEXT BOOKS :

1. Morris Mano, “Digital Design (with an introduction to the verilog HDL)", Prentice-Hall of India.
2. John F. Wakerly, “Digital Design Principles & Practices”, 4th edition, Prentice-Hall, 2005.

REFERENCE BOOKS:

1. Stephen D. Brown, and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design, 2^{nd} Edition," McGraw Hill, June, 2007.
2. William Kleitz, “Digital Electronics: A Practical Approach with VHDL”, Ninth Edition, Pearson, 2002.
3. Floyd T.L., “Digital Fundamentals ", Charles E. Merrill publishing Company, 1982.
4. Tokheim R.L., “Digital Electronics - Principles and Applications ", Tata McGraw Hill, 1999.
5. Jain R.P., “Modern Digital Electronics ", Tata McGraw Hill, 1999

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17ECCC04	SIGNALS AND SYSTEMS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Signals and Systems arise in a wide variety of fields. These concepts and techniques associated with in areas of science and technology. Signals are functions of one or more independent variables contain information about the behavior or nature of some phenomenon. Signals vary continuous / discrete in time. Systems respond to particular signals by producing other signals (output) having some desired behavior. It introduces the students to analyze signals and systems and to design systems to enhance or restore signals that have been degraded in some way.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the various classifications of Continuous time and Discrete time Signals and Systems.
2	To learn about the spectral analysis of Periodic and Aperiodic Signals using Fourier series.
3	To impart the knowledge in analysis and characterization of the CT system through Laplace transforms.
4	To learn about the analysis and characterization of the DT system through Discrete Fourier Transforms and Z Transform.

COURSE OUTCOMES

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

CO1. Classify the type of signals and systems.	Understand
CO2. Determine the time and frequency domain characteristics of continuous time periodic and aperiodic signals with the properties of Fourier Series and Fourier transform respectively.	Apply
CO3. Find the response of a continuous time LTI System using convolution.	Apply
CO4. Determine the time and frequency domain characteristics of discrete time periodic and aperiodic signals using the properties of DTFT, DFT & Z-Transforms respectively.	Apply
CO5. Compute DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithms.	Apply
CO6. Apply and characterize the causality and stability of Discrete LTI system using Z-Transforms.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	-	M	-	-	-	M	-	-	M	S	-	-
CO3	S	M	M	-	M	-	-	-	M	-	-	M	-	-	-
CO4	S	M	M	-	M	-	-	-	M	-	-	M	-	-	-
CO5	S	M	M	-	M	-	-	-	M	-	-	M	S	M	S
C06	S	S	M	-	M	-	-	-	M	-	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION OF SIGNALS AND SYSTEMS

Continuous time signals, Discrete time signals, Unit step, Unit ramp, Unit impulse – Representation of signals in terms of unit impulse, Classification of continuous time signals & Discrete time signals-Continuous time systems-Discrete time systems- Classification of continuous time systems and Discrete time systems.

ANALYSIS OF CONTINUOUS TIME SIGNALS

Fourier series analysis-Representation of Continuous time Periodic signals – Trigonometric and exponential-Spectral Properties of Periodic power signals - Properties of Continuous time Fourier series – Parseval's relation for power signals, Fourier transform analysis-Representation of Continuous time signals- Properties of Continuous time Fourier transform –Fourier transform of a Periodic function, Rayleigh's Energy theorem.

LTI CONTINUOUS TIME SYSTEM

Convolution Integral, Impulse response, Solution of Differential equation with initial conditions- Zero state response and Zero input response, Block diagram representation, Fourier methods for analysis, Laplace transform analysis.

ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS

Representation of sequences – Discrete Time Fourier Transform (DTFT) - Discrete Fourier Transform (DFT) and its properties –Fast Fourier Transform- FFT Algorithm, DIF & DIT-Z Transform-Inverse Z Transform, Unilateral Z-Transform.

LTI DT SYSTEM

Convolution sum - Impulse response and properties of LTI systems - Difference equations - Z Transform analysis - System stability and causality - Frequency response - Block Diagram representation.

TEXT BOOKS:

1. Alan V.Oppenheim, Ronald W. Schafer, "Discrete time signal processing", Pearson education , 2nd edition, 2007.
2. John G. Proakis and Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson Education, 4thEdition, 2007.

REFERENCE BOOKS:

1. B.P. Lathi, "Linear Systems & Signals", Oxford Press, Second Edition, 2009.
2. Rodger E Ziemer, William H. Tranter, D. Ronald Fannin, "Signals and Systems – continuous and Discrete", Pearson Education, 4th Edition, 2009.
3. Douglas K Linder, "Introduction to Signals and Systems",Mc-Graw Hill, 1st Edition, 1999.

COURSE DESIGNERS

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17BMCC04	BIOMEDICAL INSTRUMENTATION & MEASUREMENTS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The variety of diagnostic, control, and monitoring equipment used for medical purposes comprises an array of biomedical instrumentation. These electronic systems can be used in a physician's office, a medical laboratory, or be implanted into a patient. This course is designed to acquire knowledge about the different components of various biomedical equipment and its working principle and to measure various physiological parameters.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know about bioelectric signals, electrodes and its types.
2	To know the various Bio potential amplifiers.
3	To study about various Physiological measurements.
4	To study the recording of various cardiac signals.
5	To study about clinical laboratory instruments and blood cell counters.

COURSE OUTCOMES

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

CO1. Explain the acquisition of various bio signals using various types of Electrodes.	Understand
CO2. Examine the different blood types of cell and usage of clinical laboratory instruments.	Apply
CO5. Use bio-amplifiers in medical applications.	Apply
CO3. Record and analyze various physiological signals.	Analyze
CO4. Classify various cardiac function measurements.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	L	--	--	--	--	--	M	--	M	M
CO2	S	M	M	S	--	M	--	L	M	--	--	M	M	M	M
CO3	S	M	M	S	--	M	M	L	M	--	--	M	M	M	M
CO4	S	M	S	M	--	M	S	M	S	--	--	S	S	S	M
CO5	S	M	S	M	--	M	S	M	S	--	--	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

BIOELECTRIC SIGNALS AND ELECTRODES
Basic medical instrumentation system, Origin of Bioelectric Potential – Resting and action potential, Nernst equation, Goldman equation. Recording electrodes – Electrodes: Tissue interface, Electrolyte – skin interface, Polarization, Skin contact impedance, motion artefacts. Electrodes – Silver – silver chloride electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, Electrical conductivity of electrode jellies and creams, Types of electrodes.

BIO AMPLIFIERS
Bio amplifier, Need for Bio amplifier, Operational amplifier characteristics, Different modes of operation of differential amplifier, Basic operational amplifier circuits – Inverting, Non inverting, differential amplifier, Instrumentation amplifier. Chopper amplifier, Isolation Amplifier.

BIO SIGNALS RECORDING
ECG- Anatomy and Electrical conducting system of heart, Genesis of ECG, Einthoven triangle, Lead system, Segments and intervals of ECG, Normal and abnormal ECG wave forms, ECG Machine, Recording set up of EMG and EEG. Heart sounds and PCG, ERG, EOG.

CARDIAC FUNCTION MEASUREMENTS
Blood pressure measurement – direct and indirect method, Respiration rate measurement, Measurement of heart rate and pulse rate, Plethysmography technique. Blood flow measurement – electromagnetic, ultrasonic. Cardiac output measurement – Indication dilution method and dye dilution method

CLINICAL LABORATORY INSTRUMENTS AND BLOOD CELL COUNTERS
Spectrophotometer, colorimeter, flame photometer, auto-analyser. Types of blood cells, Methods of cell counting, coulter counters, automatic recognition and differential counting.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.
3. Arumugam, M, **"Biomedical Instrumentation"**, Anuradha publications, 2008.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation Application and Design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M **"Introduction to Biomedical Equipment Technology"**, John Wiley and sons, New York, 4th Edition, 1997.

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17BMCC05	PATHOLOGY AND MICROBIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The curriculum of pathology aims at preparing the students in basic understanding of diseases and their pathogenesis. The topics build the concepts of how human system works in altered and diseased stage under the influence of various internal and external stimuli. Thus the syllabi of pathology compliments and supplements the necessary knowledge, students have gained in physiology. The Microbiology course has been formulated to impart basic and medically relevant information on the microbes. The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included.

PRERQUISITE : NIL

COURSE OBJECTIVES

1	To understand the basic concept in pathology.
2	To understand the altered state of human body in different diseased condition.
3	To illustrate the working principle of various microscopes and demonstrate the specimen preparation.
4	To outline the pathogenesis of viral and bacterial diseases and their control.
5	To categorize the various immunological and sterilization techniques.

COURSE OUTCOMES

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

CO1. Describe the cellular responses to stress, cell degeneration, cellular repair and concepts of tumour.	Understand
CO2. Explain the causes and pathophysiology of different fluid and Haemodynamic disorders.	Understand
CO3. Apply the knowledge to operate the different types of microscopes and prepare the specimens for observation.	Apply
CO4. Identify the causes and prevention method to control various infectious diseases due to bacteria, and viruses.	Analyze
CO5. Diagnose the infectious diseases using immunological techniques like Immunofluorescence, ELISA, RIA and compare the sterilization techniques.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	M	--	--	M	--	M	M
CO2	M	--	--	--	--	--	--	--	S	--	--	S	--	M	M
CO3	S	S	M	--	--	--	--	--	S	--	--	S	M	S	M
CO4	S	S	S	--	M	M	M	--	S	--	--	S	S	S	S
CO5	S	S	S	--	M	M	--	--	S	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

CELL DEGENERATION, REPAIR AND NEOPLASIA: Introduction to pathology, Cellular responses to stress, Cellular adaptations, Cell injury and Necrosis – causes, mechanism and morphology, Apoptosis, Inflammation, Tissue repair, Neoplasia - Classification, Benign and Malignant tumours, Carcinogenesis, Etiology and Spread of tumours.

FLUID AND HEMODYNAMIC DERRANGEMENTS: Edema, Normal haemostasis and Thrombosis, Disseminated intravascular coagulation, Embolism, Infarction, Shock. Haematological disorders – Red cell Disorders, White cell disorders, Bleeding disorders.

STRUCTURE OF BACTERIA, VIRUSES AND MICROSCOPY: Morphological features and structural organization of bacteria, Bacterial growth and Nutrition, Growth curve, Culture media and its types, Culture techniques and observation of culture. Viruses – Structure, Classification and Replication. Light microscope, Bright field, Dark field, Phase contrast, Fluorescence and Electron microscope (TEM& SEM), Preparation of samples for electron microscope, Staining methods – Simple, Gram's staining and AFB staining.

IMMUNITY, INFECTION AND DISORDERS: Antigen, Antibodies and its types, Immunity – Innate and Adaptive immunity, Immunodeficiency diseases, Genetic disorders, Hypersensitivity diseases, Bacterial, Viral, Fungal, Protozoan and Helminthic diseases.

IMMUNOLOGICAL TECHNIQUES AND CONTROL OF MICROORGANISMS: Agglutination and Precipitation reactions, Immunofluorescence, ELISA, RIA. Diagnosis of Infectious Diseases. Methods of Sterilization and disinfection: Physical Methods - Dry heat, Moist heat, Filtration, Radiation, Chemical Methods – Alcohol, Aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.

TEXT BOOKS:

1. Robbins & Cotran, **"Pathologic Basis of Disease"**, 9th Edition, Saunders Co. 2014.
2. Anatha Narayanan R & Jayaram Panicker C.K, "**Text Book of Microbiology"**, 10th Edition, Orient Longman, 2017.

REFERENCES:

1. Prescott, Harley, Klein, **"Microbiology"**, 7th Edition, Mc Graw Hill, 2008.
2. Janis Kuby, **"Immunology"**, 5th Edition, W.H. Freeman and Company, New York, 2003.

COURSE DESIGNERS

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17ECCC10	LINEAR INTEGRATED CIRCUITS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Linear Integrated circuits enables the students to have an insight knowledge on fundamentals of various integrated circuits. The designed course makes the students to work on the various applications of the Integrated Circuits. This subject helps the students to design, model and develop amplifier circuits, comparators, regulators, filters, timer, D/A and A/D converters and PLL.

PREREQUISITE

17ECCC01 - Semiconductor Devices

COURSE OBJECTIVES

1	To Understand the basics of Integrated Circuits and its fabrication.
2	To get familiarized with operational amplifiers and its Characteristics.
3	To Construct various circuits using operational amplifier and analyze its performance.
4	To design and the working of waveform generators, regulators, filters and timers circuits.
5	To Understand the basic concepts of PLL.

COURSE OUTCOMES

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

CO1. Describe the Concepts of Fabrication of active and passive components	Understand
CO2. Interpret the Operational Amplifier with its characteristics.	Apply
CO3. Design and analyze the various applications of Operational Amplifier.	Analyze
CO4. Design and analyze wave generators and regulators.	Analyze
CO5. Designing and analyzing filters and Timer circuits.	Analyze
CO6. Analyze the various functional blocks of PLL.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	M	-	-	-
CO2	S	M	M	M	M	-	-	-	-	-	-	M	-	-	-
CO3	S	S	M	M	M	-	-	-	-	-	-	M	S	-	-
CO4	S	S	M	M	M	-	-	-	-	-	-	M	S	M	-
CO5	S	S	M	M	M	-	-	-	-	-	-	M	S	-	M
CO6	S	S	M	M	M	-	-	-	-	-	-	M	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTEGRATED CIRCUIT FABRICATION AND CHARACTERISTICS

Integrated Circuit Technology –Basic Monolithic Integrated Circuits-Epitaxial Growth-Masking and Etching-Diffusion of Impurities-Transistors for monolithic circuits-Monolithic Diodes-Integrated Resistors-Integrated Capacitors and Inductors-Monolithic –Circuit Layout-Additional Isolation Methods-Large Scale and Medium Scale Integration.

OPERATIONAL AMPLIFIER

Basic operational Amplifier – Ideal Operational Amplifier - Operational Amplifier Internal Circuits – Examples of IC Op Amps – FET Operational Amplifiers – DC Characteristics – AC Characteristics – Analysis of Data Sheets of an Op Amp.

OPERATIONAL AMPLIFIER APPLICATIONS

Basic Op Amp Applications – Instrumentation Amplifiers – AC Amplifiers – V to I and I to V Converters – Op Amp Circuits Using Diodes – Sample and Hold Circuits – Log/Antilog Amplifiers – Adder/ Sub tractor – Multiplier and Divider – Differentiator and Integrator – Operational Transconductance Amplifier-Pspice Simulation Tools.

COMPARATORS, REGULATORS, FILTERS AND TIMERS

Comparators – Square, Triangular and Sawtooth wave Generators, Series Op Amp Regulators – IC Voltage Regulators – 723 General Purpose Regulators – RC Active Filters – Active Filters using OTA's, Timer – Description of Functional Diagram – Monostable and Astable Operation – Schmitt Trigger

PLL, D/A AND A/D CONVERTERS

PLL – Basic Principles – Phase Detectors/ Comparators – Voltage Controlled Oscillator – Low Pass Filter – Monolithic PLL – PLL Applications – Basic DAC Techniques – A–D Converters – DAC/ ADC Specifications.

TEXT BOOKS:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuits", New Age International Publishers, 5th Edition 2018.
2. Jacob Millman,Chirstos C.Halkias,"Integrated Electronics",Tata Mc-GRAW Hill, Edition,3rd Edition, 2010

REFERENCE BOOKS:

1. Robert F Coughlin, Fredrick F.Driscoll," Operational Amplifiers and Linerar Integrated Circuits", Phi Learning,6th Edition,2009.
2. Sergio Franco,"DesignwithOperational Amplifiers and Analog Integrated Circuits", Tata Mc-GRAW Hill ,4th Edition, 2016.

COURSE DESIGNERS

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17BMCC06	BIOMEDICAL CONTROL SYSTEMS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The field of engineering, such as electrical, electronics, communications, biomedical and instrumentation, are based on control system. To enable the students to acquire fundamental knowledge gained will be useful for various applications in field of Biomedical and Technology. By studying various control systems modeling technique, time response analysis and frequency response analysis, biological control systems can be analysed and understood.

PREREQUISITE

17MABS06 - DIFFERENTIAL EQUATIONS AND TRANSFORMS

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1. Explain 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.	Understand
CO2. Comprehend the application aspects of time and frequency response in physiological control systems.	Apply
CO3. Examine the various biological control systems to meet given specifications.	Apply
CO4. Analyze the time response of various systems and discuss the concept of system stability.	Analyze
CO5. Categorize the frequency response characteristics of various systems using different charts.	Analyze
CO6. Investigate the physiological system models using software tool.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	L	--	--	--	M	--	--	M
CO2	S	M	L	L	--	M	--	L	M	--	--	M	M	M	M
CO3	S	M	L	L	--	M	--	M	M	--	--	M	M	M	S
CO4	S	M	L	M	--	--	--	--	M	--	--	S	M	M	S
CO5	S	M	M	M	M	--	--	--	M	--	--	S	S	M	S
CO6	S	M	M	M	S	M	--	M	M	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

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.

TIME RESPONSE ANALYSIS

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.

FREQUENCY RESPONSE ANALYSIS

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

BIOLOGICAL SYSTEM MODELS

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

BIOLOGICAL CONTROL SYSTEM ANALYSIS

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.

TEXT BOOKS:

1. J. Nagrath and M. Gopal, **"Control Systems Engineering"**, New Age International (P) Limited, Publishers, 5th Edition, 2008.
2. Michael C K Khoo, **"Physiological Control Systems: Analysis, Simulation, and Estimation"**, Wiley-IEEE Press, September 1999.

REFERENCES:

1. Gopal M, **“Control System – Principles and Design”**, Tata McGraw Hill, 2nd Edition, 2002.
2. Michael C K Khoo, **“Physiological control systems”,** IEEE press, John Wiley & Sons Inc, 1st Edition, 2000.
3. Benjamin C. Kuo, **“Automatic Control Systems”**, Prentice Hall of India, 1995.
4. John Enderle Susan Blanchard, Joseph Bronzino, **“Introduction to Biomedical Engineering”**, second edition, Academic Press, 2005.
5. Richard C. Dorf, Robert H. Bishop, **“Modern control systems”**, Pearson, 2004.

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17ECCC07	MICROCONTROLLERS & ITS APPLICATIONS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Microcontroller is used as the main controller in most of the embedded systems nowadays. Due to the development in VLSI technology, microcontrollers evolve which function similar to microprocessors but they have most of the peripherals built on-chip. This course makes the students to be familiar with the architecture and programming of Microcontrollers. This course also introduces the architecture and hardware features of PIC 16F877 and ARM7 (LPC2148) microcontrollers.

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To learn the concepts of microprocessors and knowledge of interfacing devices.
2	To study the Architecture of 8051 microcontroller
3	To develop skill in simple program writing of microcontroller
4	To study the interfacing and applications of microcontroller
5	To study the advanced microcontrollers.

COURSE OUTCOMES

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

CO1. Explain the concept of microprocessor and interfacing devices.	Understand
CO2. Explain the architecture and function of 8051 microcontroller	Apply
CO3. Design and implement programs on 8051 Microcontroller	Analyze
CO4. Design and implement applications using 8051 Microcontroller	Analyze
CO5. Illustrate various applications using advanced Microcontrollers.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	M	-	-	-	-	-	-	M	S	-	-
CO2	S	S	S	-	M	-	-	-	-	-	-	M	-	M	M
CO3	S	M	M	-	M	M	-	-	-	-	-	M	-	-	-
CO4	S	S	M	-	M	M	-	-	-	-	-	M	S	M	M
CO5	S	M	S	-	M	M	-	-	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTEL 8086 MICROPROCESSOR & I/O INTERFACING

Introduction to 8086 - Architecture of 8086 - Register organization – Signal Description of 8086 - Addressing modes – Data Transfer Instruction – Arithmetic Instruction - Branching Instruction - Program Transfer Instruction – simple programs- Programmable Peripheral Interface 8255 – Programmable Communication Interface 8251 USART – Programmable Interrupt Controller 8259A – Direct Memory Access Controller 8257- Programmable Interval Timer 8253 – Keyboard/Display Controller 8279.

INTEL 8051 MICROCONTROLLER

Introduction to 8 bit microcontroller – architecture of 8051- Signal descriptions of 8051- Role of PC and DPTR- Flags and PSW- CPU registers- Internal RAM & ROM- Special Function Register-Counter & Timers- Serial Communication.

ASSEMBLY LANGUAGE PROGRAM OF INTEL 8051

Interrupt- Addressing Mode- Data Transfer Instruction- Arithmetic Instruction- Logical Instruction- Jump Loop & Call Instruction- I/O Port Programming.

INTERFACING AND APPLICATION OF INTEL 8051

LCD Interfacing - A/D and D/A Interfacing- Sensor Interfacing- Relays and Optoisolators- Stepper Motor Interfacing- DC Motor Interfacing.

ADVANCED MICROCONTROLLERS

PIC 16F877 microcontroller – Architecture On chip ADC, I^2C – SPI – Watchdog timer – ARM7 (LPC2148) microcontroller – Architecture and applications.

TEXTBOOKS:

1. Muhammad Ali Mazidi and Janica Gilli Mazidi, The 8051 microcontroller and embedded systems, Pearson Education, 5th Indian reprint, 2003.
2. Frank D. Petruzella. “Programmable Logic Controllers”, McGraw–Hill Book, Company, 1989

REFERENCE BOOKS:

1. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
2. Embedded Controller Hand book, Intel Corporation, USA.
3. Microcontroller Hand Book, INTEL, 1984.
4. Ajay V.Deshmukh, “Microcontrollers- Theory and applications”, Tata McGraw-Hill, publisher,2005.

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17BMCC07	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – I	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To enable the students to understand the medical devices applied in measurement of parameters related to cardiology, neurology and to learn the instruments used for surgery, understand the need and use of some of the extracorporeal devices and respiratory measurements.

PREREQUISITE: 17BMCC04 - BIOMEDICAL INSTRUMENTATION & MEASUREMENTS

COURSE OBJECTIVES

1	To study the therapeutic equipment used in cardiac system.
2	To understand function of neurological equipment.
3	To study instruments used for surgery.
4	To understand the functioning of extracorporeal devices.
5	To understand the measurements of respiratory parameters.

COURSE OUTCOMES

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

CO1. Explain the various types of cardiac pacemaker.	Understand
CO2. Use of electroencephalogram test in many types of seizure disorder.	Apply
CO3. Utilize the different types of diathermy for internal and external surgery.	Apply
CO4. Relate the extracorporeal devices with internal organs.	Analyze
CO5. Measure the total respiratory volume using spirometer and use of ventilator.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	L	--	L	--	--	--	M	--	M	M
CO2	M	M	M	L	--	M	--	L	M	--	--	M	S	M	M
CO3	S	M	M	L	--	M	--	L	M	--	--	M	S	M	M
CO4	S	S	M	M	--	M	--	M	S	--	--	S	S	M	S
CO5	S	M	S	M	--	S	--	S	S	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

CARDIAC SYSTEM:

Cardiac pacemaker: Need for pacemaker, Types of pacemaker, Different modes of operation, Types of implantable pacemaker, Ventricular synchronous demand pacemaker, Types of batteries. Defibrillator: Need for defibrillator, DC defibrillator with discharge waveforms, Implantable defibrillator.

NEUROLOGICAL EQUIPMENT:
EEG, genesis, 10-20 electrode system, EEG Recording system, frequency bands, Computerized analysis of EEG, Evoked Potential–Visual, Auditory and Somatosensory, diagnostic interpretation, epileptic discharges. EEG Bio Feedback Instrumentation.

INSTRUMENTS FOR SURGERY:
Principle of surgical diathermy, Types of electro surgical technique, Surgical diathermy machine, coagulation modes, Electrodes for surgical diathermy, Safety aspects in surgical units, Surgical diathermy analyzers.

EXTRA CORPOREAL DEVICES:
Heart lung machine, Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, Hemo-Dialyser unit, peritoneal dialysis, Lithotripsy.

RESPIRATORY MEASUREMENT AND VENTILATOR:
Pulmonary function measurements, Respiratory volume and capacities, Basic Spirometer, Wedge spirometer, Ultrasonic spirometer, Respiratory volume measurement, Ventilator: Mechanics of respiration, Classification of ventilator, Modern ventilator.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.
3. Arumugam, M, **"Biomedical Instrumentation"**, Anuradha publications, 2008.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation application and design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M **"Introduction to Biomedical equipment technology"**, John Wiley and sons, New York, 4th Edition, 1997.

COURSE DESIGNERS

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17BMCC08	BIOMEDICAL SIGNAL PROCESSING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To learn the fundamental concepts of signal processing and to apply common signal processing techniques for various biomedical signals.

PREREQUISITE: 17ECCC04 - SIGNALS AND SYSTEMS

COURSE OBJECTIVES

1	To make them understand the fundamentals of signal processing for various bio-signal analysis.
2	To impart knowledge about filter characteristics and to design various filters.
3	To provide an in-depth knowledge about the basic concepts of wavelet and speech analysis.
4	To apply various signal processing techniques in analyzing the various bio signals.
5	To study about the characteristics of non stationary signals.

COURSE OUTCOMES

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

CO1. Illustrate the nature of biomedical signals and related concepts.	Analyze
CO2. Examine the filters to remove noise from biomedical signals.	Apply
CO3. Explain in-depth knowledge about the basic concepts of wavelet and speech analysis.	Understand
CO4. Analyze event detection techniques for EEG and ECG signals.	Analyze
CO5. Categorize the various case studies approach in processing the bio-signals.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	S	M	M	--	--	M	--	--	S	M	M	M
CO2	S	M	L	M	M	L	--	--	M	--	--	S	M	M	M
CO3	M	M	L	--	--	--	--	--	M	--	--	M	--	M	M
CO4	S	S	M	S	M	M	--	--	M	--	--	S	M	M	S
CO5	S	S	M	S	M	M	--	--	M	--	--	S	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF SIGNAL PROCESSING
Sampling and aliasing, Signal reconstruction, Signal conversion systems, Circular convolution, Correlation-Autocorrelation – Cross correlation, FFT - decimation in time algorithm, Decimation in Frequency algorithm. Different types of bioelectric signals and its basic characteristics.

DIGITAL FILTER DESIGN
Basics of filter, Design of IIR filter-impulse invariant method – Bilinear Transformation Method Characteristics of FIR filter, FIR filter design using windowing techniques- Rectangular window – Hamming window – Hanning window.

WAVELET AND SPEECH PROCESSING
Introduction to wavelets, Time frequency representation, Discrete wavelet transform, pyramid algorithm, Comparison of Fourier transform and wavelet transform, Speech analysis – Cepstrum – Homomorphic filtering of speech signals.

ANALYSIS OF BIOSIGNALS
Automatic analysis and classification of ECG, P-wave detection, QRS complex detection, Correlation analysis of ECG signals, Signal averaged ECG, Analysis of Heart Rate variability, Synchronized averaging of PCG envelopes, envelogram, Analysis of PCG signal, Analysis of EMG signal.

CASE STUDIES IN BSP
ECG rhythm analysis, normal and ectopic ECG beats, analysis of exercise ECG, Analysis of respiration, spectral analysis of EEG signals, Case studies- in ECG and PCG, PCG and carotid pulse, ECG and atrial Electrogram, Cardio respiratory interaction, EMG and Vibromyogram (VMG).

TEXT BOOKS:

1. John G, Proakis and Dimitris Manolakis G, **"Digital Signal Processing, Algorithms and Applications"**, PHI of India Ltd., New Delhi, 4th Edition, 2007.
2. Rangaraj M Rangayyan, **"Biomedical signal processing"**, IEEE press, 1st Edition, 2002.

REFERENCES:

1. Reddy D.C, **"Biomedical Signal Processing: Principles and Techniques"**, Tata McGraw-Hill, New Delhi, 2nd Edition, 2005.
2. Sanjit.K, Mitra **"Digital Signal Processing - A Computer Based Approach"**, Tata McGraw-Hill, New Delhi, 4th Edition, 2011.

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17BMCC09	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – II	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To offer overall idea about the application of ultrasonic and diathermy principles in clinical applications and transmission of biosignals using telemetry techniques. To understand sources of leakage current and method of monitoring it.

PREREQUISITE: 17BMCC07 - DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – I

COURSE OBJECTIVES

1	To study various display techniques and use of ultrasonic in various fields of medicine.
2	To understand various patient monitoring systems and transmission of biosignals.
3	To study the clinical application of diathermy principles.
4	To understand diagnostic applications of endoscopy and thermography.
5	To study sources of leakage current and method of monitoring it.

COURSE OUTCOMES

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

CO1. Describe the patient monitoring system and biotelemetry using physiological signal.	Understand
CO2. Operate ultrasound and pulse echo techniques in A, B, M modes.	Apply
CO3. Compare physiotherapy and electrotherapy equipment during surgery.	Analyze
CO4. Examine the special diagnostic equipment like endoscopy, thermography and anesthesia.	Apply
CO5. Evaluate the electric shock hazards using biomedical equipment.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	--	--	--	--	M	--	M	M
CO2	S	M	M	M	--	L	--	L	M	--	--	S	S	M	M
CO3	S	M	S	M	--	M	--	M	S	--	--	S	S	M	S
CO4	S	M	M	M	--	L	--	L	M	--	--	S	S	M	M
CO5	S	S	S	S	--	S	--	S	S	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

ULTRASONIC TECHNIQUES FOR DIAGNOSIS:

Physics of Ultrasound, Basic pulse echo apparatus, Swept gain control, Generation and detection of ultrasound, display techniques A, B, M modes, Applications of A-Scan, Echo cardiograph, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, Digital scan converter.

PATIENT MONITORING AND BIOTELEMETRY:
Patient monitoring system: Selection of system parameters, Cardiac monitor, Bed side monitoring system, central monitoring system, Biotelemetry - wireless telemetry, single channel telemetry, multichannel telemetry, multi patient telemetry, Transmission of analog physiological signals over telephone.

PHYSIOTHERAPHY AND ELECTRO THERAPHY:
High frequency heat therapy, short wave diathermy, Methods of applying electrodes in short wave diathermy, ultrasonic diathermy, microwave diathermy, Electrotherapy-Different types of current waveforms used in electrotherapy, Patient relief from electrical stimulation- Transcutaneous electrical Nerve stimulator, spinal card stimulator and magnetic stimulation.

SPECIAL DIAGNOSTIC TECHNIQUES:
Endoscopy, Types of endoscopy, Thermography: Medical thermography, Physics of thermography, Infra-red, microwave and liquid crystal thermography, Thermography equipment, Need for anesthesia, Anesthesia machine.

PATIENT SAFETY:
Electric shock hazards. Effects of electric currents on human body, Sources of leakage current, Types of leakage currents, Precautions to minimize electric shock hazards, Micro and Macro shock, Testing of biomedical equipment, monitoring circuits, earthing schemes.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.
3. Arumugam, M, **"Biomedical instrumentation"**, Anuradha publications, 2008.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation application and design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M, **"Introduction to Biomedical equipment technology"**, John Wiley and sons, New York, 4th Edition, 1997.

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17BMCC10	MEDICAL IMAGE PROCESSING AND ANALYSIS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To learn the fundamental concepts of medical image acquisition and understand how to apply the image processing techniques for various medical images.

PREREQUISITE: 17BMCC08 - BIOMEDICAL SIGNAL PROCESSING

COURSE OBJECTIVES

1	To learn the image fundamentals and mathematical transforms necessary for image processing.
2	To study the various image enhancement techniques.
3	To study about the various segmentation techniques applied to Medical Images.
4	To gain knowledge about the basic concepts of image compression procedures.
5	To apply various image restoration procedures in Medical images.

COURSE OUTCOMES

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

CO1. Summarize the general terminology of digital image processing.	Understanding
CO2. Examine the need for image transforms and their types both in spatial and frequency domain.	Apply
CO3. Classify different types of image segmentation and apply restoration techniques.	Analyze
CO4. Analyze the image compression models and image compression techniques.	Analyze
CO5. Illustrate various methodologies for image segmentation in medical imaging.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	--	--	M	--	--	--	--	--	--	M	--	M	M
CO2	S	S	M	M	S	M	--	--	S	--	--	S	M	M	M
CO3	S	S	M	M	S	M	--	--	S	--	--	S	M	M	S
CO4	S	S	M	M	S	M	--	--	S	--	--	S	M	M	S
CO5	S	S	M	M	S	M	--	M	S	--	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

DIGITAL IMAGE FUNDAMENTALS

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.

IMAGE ENHANCEMENT

Basic gray level transformation, Histogram processing, Smoothening by spatial filters – Sharpening by spatial filters, Smoothening- frequency domain filters, Sharpening - frequency domain filters, Color image Processing- color models – Pseudo color image processing – Color Image Transformation – Smoothening – Sharpening.

IMAGE SEGMENTATION AND OBJECT RECOGNITION

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding foundation – Basic global thresholding – Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm, Patterns and pattern classes, Recognition based on decision theoretic methods – matching, Optimum statistical classifiers.

IMAGE COMPRESSION

Introduction – Principle of compression – Types of compression – Run length Encoding – Huffman Coding – Modified Huffman Coding – Modified READ – LZW – Arithmetic Coding – JPEG – Other State-of-the-Art Image Compression – Image Compression Standard File Formats.

IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images.

TEXT BOOKS:

1. Rafael C, Gonzalez and Richard E Woods, **"Digital Image Processing"**, Pearson Education Asia, 3rd Edition, 2007.
2. Anil K Jain, **"Fundamentals of Digital Image Processing"**, Prentice Hall of India, 2nd Edition, 1997.

REFERENCES:

1. William K Pratt, **"Digital Image Processing"**, John Wiley, 4th Edition, 2007.
2. Albert Macouski, **"Medical Imaging systems"**, Prentice Hall, New Jersey, 2nd Edition, 1997.

COURSE DESIGNERS

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17BMCC11	REHABILITATION ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Rehabilitation is a branch of engineering which focuses on the existing capacities of the handicapped person, and brings him to the optimum level of his or her functional ability by thecombined and coordinated use of medical, social, educational and vocationalmeasures. It makes life for the handicapped individual more meaningful, moreproductive and therefore adds more life to years.

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To understand the rehabilitation concepts.
2	To understand the Engineering Concepts of Sensory & Motor rehabilitation.
3	To study different types of Therapeutic Exercise Techniques.
4	To Understand the different types Hearing aids, visual aids and their application in biomedical field.
5	To study the various orthotic devices and prosthetic devices to overcome orthopedic problems.

COURSE OUTCOMES

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

CO1. Describe the concept of rehabilitation and its future development.	Understand
CO2. Analyze the engineering concepts in sensory & motor rehabilitation.	Analyze
CO3. Apply the types of therapeutic exercise technique to benefit the society.	Apply
CO4. Outline the different types Hearing aids, visual aids and their application.	Analyze
CO5. Classify the different types of models of Hand and arm replacement.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	--	--	M	--	M	M	--	--	M	S	M	S
CO2	S	S	S	S	M	M	--	M	M	--	--	S	S	M	S
CO3	S	S	M	M	--	L	--	--	M	--	--	S	S	M	S
CO4	S	S	S	S	M	M	--	S	M	--	--	S	S	M	S
CO5	S	S	S	S	M	M	--	S	M	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO REHABILITATION

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

PRINCIPLES OF REHABILITATION
Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering-Key Engineering Principles, Key Ergonomic Principles -Practice of Rehabilitation and Assistive Technology.

THERAPEUTIC EXERCISE TECHNIQUE
Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercise-Strength training, Types ofContraction, Mobilization exercises, Endurance exercises.

MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY
Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES
General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers-FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics; Myoelectric controlled prosthetics and Externally powered limb prosthetics.Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

TEXT BOOKS:

1. Sunder, **"Textbook of Rehabilitation"**, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007
2. Joseph D.Bronzino, **"The Biomedical Engineering Handbook"**, Third Edition-3 volume set, Taylor & Francis, 2006.

REFERENCES:

1. Horia-Nocholai Teodorecu, L.C.Jain, **"Intelligent systems and technologies in rehabilitation Engineering"**, CRC; December 2000.
2. Keswick. J., **"What is Rehabilitation Engineering, Annual Reviews of Rehabilitation",** Springer-Verlag, New York, 1982.
3. Warren E. Finn,Peter G. LoPresti, **"Handbook of Neuroprosthetic Methods"**, CRC; Edition 2002.
4. Rory A Cooper (Editor), HisaichiOhnabe (Editor), Douglas A. Hobson (Editor), **"An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering"**, CRC Press, 2006.

COURSE DESIGNERS

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17ECCC81	SEMICONDUCTOR DEVICES LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To reinforce learning in the accompanying semiconductor devices course through hands-on experience by examining the electrical characteristics of various semiconductor devices, such as diodes, BJTs and FETs. To provide the student with the capability for performing various analysis of semiconductor devices.

PRERQUISITE- NIL

COURSE OBJECTIVES

1	To emphasize the practical, hands-on component of this course.
2	To complement the theoretical material presented in lecture, and as such, is integral and indispensible to the mastery of the subject.
3	To study experimentally the characteristics of diodes, BJT's and FET's.
4	To verify practically the response of various special purpose electron devices.
5	To provide students engineering skills by way of breadboard circuit design with electronic devices and components.

COURSE OUTCOMES

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

CO1. Construct and find the ripple factor and efficiency of HWR and FWR by conducting experiments.	Apply
CO2. Construct clipper and clamper circuits for any given specifications and illustrate their output.	Apply
CO3. Determine the given transistor parameters from the characteristics of BJT in CE and CC Configuration.	Apply
CO4. Design transistor voltage regulator for given specifications and verify its output.	Analyze
CO5. Examine the characteristics of SCR, DIAC and TRIAC.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	-	-	M	-	M	-	M	-	-	-	-
CO2	S	M	M	-	-	-	M	-	M	-	M	-	-	-	-
CO3	S	M	M	-	-	-	M	-	M	-	M	-	-	-	-
CO4	S	M	M	-	-	-	M	-	M	-	M	-	S	M	M
CO5	S	M	M	-	-	-	M	-	M	-	M	-	S	-	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Half Wave Rectifier
2. Full Wave Rectifier
3. Clipper
4. Clamper
5. Input/output Characteristics of CE Amplifier
6. Input/output Characteristics of CC Amplifier
7. Transfer Characteristics of JFET
8. Voltage Regulator
9. TRIAC, DIAC
10. SCR

COURSE DESIGNERS

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3	Mr.N.Manikanda Devarajan	Assistant Professor	ECE	manikandadevarajan@vmkvec.edu.in
4	Mr.S.Selvam	Assistant Professor (Gr-II)	ECE	selvam@avit.ac.in

17BTCC81	BIOCHEMISTRY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course is a laboratory course that focuses on developing the skills of the students by providing hands on training in various techniques in Biochemistry

PREREQUISITE - NIL

COURSE OBJECTIVES

1.	To Understand laboratory safety and standard operating procedures of common laboratory equipment's.
2.	To impart skills in preparation of solutions and biological buffers.
3.	To extend knowledge in analysis & estimation of biomolecules

COURSE OUTCOMES

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

CO1. Observe safe laboratory practices and handle the equipment safely	Understand
CO2. Prepare solutions and biological buffers	Apply
CO3. Estimate the quantity of lipids	Analyze
CO4. Separate biomolecules from various source	Analyze
CO5. Determine the quality and quantity of biomolecules	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	-	-	-	-	-	-	-	M	M	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	-	M	-	-	-	-	-	-	-	M	M	-
CO5	S	M	M	M	M	-	-	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. pH measurements and Buffer preparations.

TITRIMETRIC EXPERIMENTS

2. Estimation of Ascorbic acid by Titrimetric method using 2, 6 Dichloro phenol indophenols.
3. Determination of Saponification value of Edible oil
4. Determination of Acid number of Edible oils.
5. Determination of Iodine value of Oil.

BIOCHEMICAL PREPARATIONS

6. Isolation of Chloroplast from Spinach leaves.
7. Cheese Production from Milk.
8. Casein from Milk.
9. Starch from Potato.

REFERENCES:

1. Laboratory Manual.

COURSE DESIGNERS

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1	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in
2	Dr.R.Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in

17ECCC82	DIGITAL LOGIC CIRCUITS & DESIGN LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To provide experience & explore designs in analyzing and testing of digital logic circuits like combinational and sequential circuits using lab instruments as well as simulation software.

Prerequisite : Basic Electrical and Electronics Engineering

PRERQUISITE

17EEES03 - Basics of Electrical and Electronics Engineering

COURSE OBJECTIVES

1	To impart the knowledge in analysis and design of various combinational logic circuits.
2	To learn about design and analysis of sequential circuits using flip flops.
3	To Expose students about design and simulation of logic circuits using HDL.

COURSE OUTCOMES

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

CO1.Construct various logic circuits.	Apply
CO2. Demonstrate the various combinational logic circuits by using discrete components	Apply
CO3. Analyze different sequential logic circuits by using discrete components.	Analyze
CO4. Test the various digital logic circuits by using simulation software.	Evaluate
CO5. Measure and record the experimental data for various digital circuits.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	-	-	-	M	-	-	L	-	-	-
CO2	S	-	-	-	S	-	-	-	M	-	-	L	-	-	-
CO3	S	M	M	M	M	-	-	-	M	-	-	L	S	-	-
CO4	S	M	-	-	M	-	-	-	M	-	-	L	S	S	M
CO5	S	M	-	-	M	-	-	-	M	-	-	L	S	M	M

S- Strong; M-Medium; L-Low

List of Experiments

Hardware Experiments

1. Design and implementation of Adders using logic gates.
2. Design and implementation of Sub tractors using logic gates.
3. Design and implementation of BCD to Excess -3 code converter using logic gates
4. Design and implementation of Binary to Gray code converter using logic gates
5. Design and implementation of 4 bit BCD adder using IC 7483
6. Design and implementation of 2 Bit Magnitude comparator using logic gates
7. Design and implementation of Multiplexer and De-Multiplexer using logic gates
8. Design and implementation of encoder and decoder using logic gates
9. Design and implementation of 3 bit synchronous up/down counter.
10. Implementation of SISO, SIPO, and PISO shift registers using flip flops.

Software Experiments using HDL

1. Design and Simulation of Full adder circuit using Gate level modelling
2. Design and Simulation of 2X2 multiplier circuit using structural level modeling.
3. Design and Simulation of 8 to 1 Multiplexer circuit using behavioural level modeling.

COURSE DESIGNERS

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17ECCC83	ANANLOG CIRCUITS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The goal of this lab is to supplement the theory course Analog Circuits. Students will gain experience in Analog circuits design for given specification. They will analyze and test electronic circuits using simulation software and laboratory instruments.

PRERQUISITE

17ECCC01 - Semiconductor Devices

COURSE OBJECTIVES

1	To impart the design knowledge of various small signal amplifier circuits
2	To design the feedback amplifier and Oscillator
3	To study the characteristics of Power & Tuned amplifiers circuits

COURSE OUTCOMES

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

CO1. Design & Simulation of Compound configurations of analog circuits.	Apply
CO2. Apply the concepts of transistor biasing to study the small signal behavior of BJT for Amplification	Apply
CO3. Design and infer the frequency response and bandwidth of Feedback amplifiers.	Analyze
CO4. Investigate the concepts of Power & Tuned amplifiers	Analyze
CO5. Simulate & Estimate the frequency of LC and RC Oscillators	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	-	-	-	M	-	-	M	S	-	-
CO2	S	M	M	M	M	-	-	-	M	-	-	M	-	-	-
CO3	S	S	M	M	M	-	-	-	M	-	-	M	-	-	-
CO4	S	S	M	M	M	-	-	-	M	-	-	M	S	S	-
CO5	S	S	S	S	S	M	-	-	M	M	-	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Design, Simulation and Hardware realization of Single Stage Common Emitter amplifier for given specification
2. Simulation & Hardware realization of Feedback amplifiers and its frequency analysis
   a) Voltage Series
   b) Current Shunt
3. Design, Simulation and Hardware realization of Sinusoidal waveform generators.
   a) RC Oscillators
   b) LC Oscillators
4. Design and simulation of Power amplifiers
5. Frequency Response characterization of Tuned amplifier circuit.
   a) Single Tuned
   b) Double Tuned
6. Design and hardware realization of Multistage Amplifier for given specification
   a) Cascade
   b) Darlington
7. Design and simulation of Differential pair circuit with active load and current references and its frequency analysis.

COURSE DESIGNERS

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17BMCC81	BIO TRANSDUCERS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The goals of this course are to supplement the theory course biosensors and transducers and to assist the students in obtaining a better understanding the characteristics and working of transducers in various applications.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To construct and give the characteristics of unidirectional and bidirectional potentiometer transducers.
2	To compare signal conditioning circuits of temperature transducers such as RTD and thermocouple.
3	To distinguish the characteristics and the working principles of optical transducers.

COURSE OUTCOMES

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

CO1. Model a setup for measuring the strain gauge and potentiometer.	Apply
CO2. Apply the transducers for measuring the linear variable differential transformer.	Apply
CO3. Analyze the various inputs like pressure, temperature, light and weight.	Analyze
CO4. Categorize the various temperature transducers like thermistor, RTD and thermocouples.	Analyze
CO5. Experiment the characteristics of optical transducers.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	--	S	--	--	--	--	M	--	--	S	M	M	M
CO2	S	S	--	S	--	--	--	--	M	--	--	S	M	M	M
CO3	S	S	--	S	--	--	--	--	S	--	--	S	S	M	S
CO4	S	S	--	S	--	--	--	--	S	--	--	S	S	M	S
CO5	S	S	--	S	--	--	--	--	M	--	--	S	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

<u>LIST OF EXPERIMENTS</u>

1. Characteristics of Temperature Transducers.
2. Temperature Measurement using Thermistor and its Linearization characteristics.
3. Characteristics of Optical Transducer.
4. Characteristics of LVDT.
5. Characteristics of Hall effect Transducer.

6. Characteristics of Strain Gauge.
7. Characteristics of Potentiometer Transducer.
8. Characteristics of Pressure transducer
9. Characteristics of piezo electric transducers
10. Characteristics of piezo resistive transducers

REFERENCES:

1. Department Lab Manual.

COURSE DESIGNERS

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3	Mr.K.Natarajan	Associate Professor	BME	natarajank@vmkvec.edu.in

17ECCC94	LINEAR INTEGRATED CIRCUITS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE:
To acquire knowledge on designing amplifier and oscillator circuits using operational amplifiers.

PRERQUISITE – NIL

COURSE OBJECTIVES

1. To Learn the design of basic operational amplifier circuits.
2. To provide the knowledge of designing application circuits using operational amplifiers.
3. To understand the functionality of the circuits using op-amp and IC555.

COURSE OUTCOMES

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

CO1. Design and verify the performance of basic circuits with Op-Amp used as inverting, Non-Inverting amplifier, Integrator and Differentiator, etc.	Apply
CO2. Realize and Simulate the circuit for various applications using operational amplifiers.	Analyze
CO3. Realize active networks using driving point functions and transfer functions using simulation tools.	Analyze
CO4. Demonstrate the use of Phase Locked Loops (PLL) and IC 555 Timers using simulation tools.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	-	-	-	-	M	-	-	L	-	-	-
CO2	S	S	S	-	M	-	-	-	M	-	-	L	S	M	-
CO3	S	S	S	M	M	-	-	-	M	-	-	L	S	M	-
CO4	S	S	S	M	M	-	-	-	M	-	-	M	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Design of Inverting and Non-Inverting amplifier using operational amplifier.
2. Design of Adders and Subtractors using operational amplifier.
3. Design of Integrators and Differentiators using operational amplifiers.
4. Design of comparators using operational amplifiers.
5. Design of rectifiers using operational amplifiers.
6. Design of oscillators using operational amplifier.

7. Design of Astable and Monostable Multivibrators using IC555 Timer
8. Design of filters using operational amplifier.
9. Design of Digital to analog converter and Analog to Digital converters.
10. Design and implementation of Phase Locked Loops.

REFERENCE

1. Laboratory Reference Manual

COURSE DESIGNERS

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17BMCC82	BIOMEDICAL INSTRUMENTATION LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The curriculum of biomedical instrumentation lab is concerned to enable the students to know and operate the various biomedical instruments for measuring and diagnosing biological signals.

PRERQUISITE : NIL

COURSE OBJECTIVES

1	Design of amplifiers for biological signals.
2	Recording and analysis of bio signals.
3	Measurement of PH.
4	Study and measurement of blood pressure.
5	Measurement of galvanic skin resistance.

COURSE OUTCOMES

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

CO1. Design operational amplifier for inverting and non-inverting mode.	Create
CO2. Record and analyze EEG, ECG, EMG signals.	Analyze
CO3. Measure of PH value of a given solution.	Evaluate
CO4. Measure blood pressure non-invasively.	Evaluate
CO5. Design Filters for bio signals.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	--	M	--	--	S	--	--	S	M	M	M
CO2	S	S	M	M	S	M	--	--	S	--	--	S	M	M	S
CO3	S	S	S	M	--	M	--	--	S	--	--	S	M	M	S
CO4	S	S	S	M	--	M	--	--	S	--	--	S	M	M	M
CO5	S	S	S	S	--	M	--	--	S	--	--	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

List of Experiments

1. Blood pressure measurement using sphygmomanometer
2. Design of instrumentation amplifier
3. Measurement PH using PH meter
4. Galvanic Skin resistance measurement
5. Recording of ECG using ECG simulator
6. Recording of EEG using EEG simulator
7. Recording of EMG using EMG simulator
8. Optical Isolation Amplifier
9. Study of Phono Cardiogram (PCG)
10. Study of Types of electrodes

REFERENCES:

Department Lab Manual

COURSE DESIGNERS

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1	Dr. N.Babu	Professor	BME	babu@vmkvec.edu.in
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17BMCC83	PATHOLOGY AND MICROBIOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The curriculum of pathology and microbiology lab is concerned with the diagnosis of diseases through the use of clinical laboratory tests. These tests help doctors to detect, diagnose and treat diseases. These tests are performed by analyzing body fluids, tissues, blood typing, microorganism screening, chemical analyses, cell counts of human body etc.

PRERQUISITE: NIL

COURSE OBJECTIVES

1	To demonstrate the tissue processing, section cutting and handling of light microscope.
2	To determine the blood group and analyze the cross matching.
3	To estimate the various haematological parameters in human blood.
4	To enumerate the total and differential count of blood cells.
5	To diagnose the typhoid fever by widal test.

COURSE OUTCOMES

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

CO1. Describe the different tissue processing and sectioning techniques and working principle and maintenance of light microscopes.	Understand
CO2. Determine the human blood groups and the significance of cross matching.	Apply
CO3. Analyze various haematological parameters such as haemoglobin, bleeding time, and clotting time.	Analyze
CO4. Estimate the total RBC count and Differential WBC count.	Analyze
CO5. Diagnose the typhoid fever and examine the morphology of bacteria.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	--	--	--	--	--	--	--	--	--	S	M	--	--
CO2	S	S	L	S	--	M	--	--	M	--	--	S	M	M	S
CO3	S	S	L	S	--	M	--	--	M	--	--	S	M	M	S
CO4	S	S	L	S	--	M	--	--	M	--	--	S	M	M	S
CO5	S	S	L	S	--	M	--	--	M	--	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

<u>LIST OF EXPERIMENTS</u>

1. ABO blood grouping.
2. Cross matching of Blood.

3. Haemoglobin Estimation.
4. Bleeding time and clotting time.
5. Urine physical and chemical examination.
6. Study and Handling of Light Microscope.
7. Total RBC Count.
8. Peripheral smear study (i) Morphology (ii) WBC Differential count.
9. Manual paraffin tissue processing and section cutting (demonstration)
10. Cryo processing of tissue and cryosectioning (demonstration)
11. Simple staining.
12. Gram's staining.
13. Widal slide test.

REFERENCES:

1. S. Ramakrishnan, K N Sulochana, **"Manual of Medical Laboratory Techniques"**, First Edition, Jaypee Brothers Medical Publishers, 2012.
2. **Department Lab Manual**.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.K. Natarajan	Associate Professor	BME	natarajank@vmkvec.edu.in
2	Ms.Santhoshini Arulvallal	Assistant Professor (Gr-I)	BME	santhoshiniarulvallal@avit.ac.in

17ECCC95	MICROCONTROLLERS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE:

Microcontroller is one of the usually used methods in many electronic systems and automatic devices. It is essential to know their operation and how they can be used in automated control system applications. The main objective of this lab course is to gain the practical hands on experience of programming the 8086 microprocessor and 8051 microcontroller and gain knowledge on interfacing of different peripherals to microcontroller. Students can be able to write the assembly language programming skills, knowledge in interfacing devices and real time applications of microcontroller.

PRERQUISITE – Nil

COURSE OBJECTIVES

1. To Learns Assembly Language Programming For Arithmetic Operations Using 8051.
2. To Study The Various Peripheral Devices And Interfacing With Microcontroller.
3. To Expand Writing Skills For Assembly Language Programming For Microcontroller.
4. Develop Assembly Language Programs For Various Applications Using 8051 Microcontroller.

COURSE OUTCOMES

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

CO1. Write ALP Programming For Microprocessor And Microcontroller	Understand
CO2. Interface Different I/Os With Microcontroller	Apply
CO3. Generate Different Waveforms Using Microcontroller	Apply
CO4. Design Circuits For Various Applications Using Microcontrollers	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	S	-	-	-	S	L	-	M	-	-	-
CO2	S	S	M	-	S	M	-	-	S	L	-	M	S	M	-
CO3	S	S	M	-	S	M	-	-	S	L	-	M	S	-	-
CO4	S	S	M	-	S	S	-	-	S	L	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

<u>LIST OF EXPERIMENTS</u>

1. 8085 & 8086 Assembly Language Program (ALP) for Arithmetic Operations.
2. 8051 Assembly Language Program (ALP) for Arithmetic Operations.
3. 8051 Assembly Language Program (ALP) for Logical Operations.

4. 8051 Assembly Language Program (ALP) for Bit Manipulation Operations.
5. 8051 Assembly Language Program (ALP) for arrange the numbers in Ascending and Descending order.
6. 8051 Assembly Language Program (ALP) for Interrupt & UART Operations.
7. Interfacing an ADC to 8051 Controller.
8. Interfacing DAC to 8051 Controller and generate Square, Triangular & Saw-tooth waveform.
9. Interfacing a Stepper motor to 8051 Controller and operate it in clockwise and anti-clockwise directions.

Interfacing a Keyboard & Display controller (8279) to 8051 Controller.

REFERENCE

1. Laboratory Reference Manual

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1	Mr. R.Karthikeyan	rrmdkarthikeyan@avit.ac.in
2	Dr. R.Ramani	ramaniapece@gmail.com
3	Mr. N.Manikandadevarajan	manikandadevarajan@vmkvec.edu.in
4	Mr. G.Suresh kumar	sureshkumar@vmkvec.edu.in

17BMCC84	BIOMEDICAL SIGNAL AND IMAGE PROCESSING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE
To gain the practical knowledge about the various bio signals, imaging and its characteristics.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To represent the basic discrete time signals and analyzes it.
2	To design the IIR and FIR filter.
3	To analyze various types of bio signals and study its characteristics.
4	To practice the basic image processing techniques.
5	To enhance the medical images by applying various filters.

COURSE OUTCOMES

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

CO1. Model the various types of processing techniques carried out on biomedical signals which meet the current Industry needs.	Apply
CO2. Design model algorithm for image processing techniques.	Create
CO3. Create simulation model and validate its functionality in real time systems.	Create
CO4. Design and test image and signal processing algorithms.	Create
CO5. Apply image processing techniques to basic biomedical applications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	--	--	--	S	--	--	S	S	M	M
CO2	S	S	S	S	S	--	--	--	S	--	--	S	S	M	S
CO3	S	S	S	S	S	--	--	--	S	--	--	S	S	M	S
CO4	S	S	S	S	S	--	--	--	S	--	--	S	S	M	S
CO5	S	M	M	M	M	--	--	--	S	--	--	S	S	M	M

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE
BIOMEDICAL SIGNAL PROCESSING
1. Representation of basic discrete time signals.
2. Computation of convolution –linear convolution.
3. Response of a difference equation to initial conditions; stability.
4. DFT and FFT computation.
5. FIR filter design using windowing techniques.

6. IIR filters design-digital Butterworth filter and Chebyshev filter.
7. Simulation of Bio-signals.
8. Analysis of ECG, EEG & EMG signals.

MEDICAL IMAGE PROCESSING
1. Study of basic functions, Arithmetic operations on images, Image Complement.
2. Histogram Processing – Techniques.
3. Image cropping.
4. Line and Edge detection.
5. FFT and DCT of images.
6. Contact stretching, Threshold technique - Enhancement.
7. Adaptive filters, Sharpening and smoothing Filters.
8. Compression technique.

TEXT BOOKS:
Department Lab Manual

REFERENCES:

1. Sanjit K. Mitra, **"Digital Signal Processing – A Computer Based Approach"**, Tata Mc Graw Hill, 2007.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, **"Digital Image Processing using MATLAB"**, Pearson Education, Inc., 2004.

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. R. Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in
2	Ms.Santhoshini Arulvallal	Assistant Professor (Gr-I)	BME	santhoshiniarulvallal@avit.ac.in
3	Mr. S. Mathankumar	Associate Professor	BME	mathankumar@vmkvec.edu.in

17BMCC85	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE
The curriculum ofdiagnostic and therapeutic equipment labis concerned to enable the students to know and operate the various diagnostic and therapeutic equipment.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To study the application of diathermy.
2	To recording and diagnosis using bio signals.
3	To understanding biotelemetry.
4	To study of radiotherapy equipment.
5	To study of Lithotripsy.

COURSE OUTCOMES

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

CO1. Apply Diathermy for treatment.	Apply
CO2. Record and analyze EOG, ECG, EMG signals.	Analyze
CO3. Understand the concepts of sending and receiving the bio signals.	Understand
CO4. Use lithotripter for kidney stones.	Apply
CO5. Examine the operation of radiotherapy equipment.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	--	S	--	--	--	--	M	--	--	L	S	M	M
CO2	S	S	M	S	--	--	--	--	M	--	--	M	S	M	M
CO3	M	M	--	M	--	--	--	--	M	--	--	L	M	M	M
CO4	S	S	--	S	--	--	--	--	M	--	--	M	S	M	M
CO5	S	S	--	S	--	--	--	--	M	--	--	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS
List of Experiments

1. 12 Lead ECG
2. Recording of EEG
3. Electro occulo graph (EOG)
4. Short wave diathermy
5. Surgical diathermy

6. Recording of EMG
7. Ultrasound blood flow meter
8. Biotelemetry
9. Study of Lithotripsy
10. Study of radiotherapy equipment

REFERENCES:
Department Lab Manual

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
2	Ms.R.Sandhiya	Assistant Professor (Gr-I)	BME	sandhiya@avit.ac.in
3	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in

17BMCC86	HOSPITAL TRAINING - I	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The purpose of this training is to provide exposure to the working environment of various hospitals and research institution. During this period, the Students will get hands on training in the diverse areas of biomedical.

PREREQUISITE:NIL

COURSE OBJECTIVES

1	Observe medical professionals at work in the wards and the roles of Allied Health Professionals.
2	Provide access to healthcare Professionals to get a better understanding of their work.
3	Demonstrate patient-care in a hospital setting.
4	To give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
5	For enabling the students to gain experience in organization.

COURSE OUTCOMES

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

CO1. Examine patient- centered approach in healthcare.	Apply
CO2. Use the knowledge of one‘s own role and those of other professions to address the healthcare needs of populations and patients served.	Apply
CO3. Outline the importance of inter-professional collaboration in healthcare.	Analyze
CO4. Support with other health professionals in a respectful and responsible manner.	Evaluate
CO5. Evaluate a patient-centered inter-professional health improvement plan based upon the patient‘s perceived needs.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	M	L	--	S	S	--	--	S	M	S	S
CO2	S	M	L	M	M	L	--	S	S	--	M	S	M	S	S
CO3	S	S	M	M	M	M	--	M	S	--	--	S	M	S	S
CO4	S	S	S	S	M	S	--	M	S	M	M	S	M	S	S
CO5	S	S	S	S	M	S	--	M	S	M	M	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

- Students need to complete training in any leading Multi-speciality hospital for a period of minimum 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.

- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.NO.	DEPARTMENT 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

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.Nagappan	Professor & Principal	BME	Principal.vmkvec@vmu.ac.in
2	Ms.B.Farhana Ansoor	Assistant Professor (G-I)	BME	farhanaansoor@avit.ac.in
3	Mr.S.Mathankumar	Associate Professor	BME	mathankumar@vmkvc.edu.in

17BMCC87	HOSPITAL TRAINING - II	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To provide hands-on experience at site where biomedical equipments are manufactured and utilized (Hospitals).

PREREQUISITE: 17BMCC86 - HOSPITAL TRAINING -I

COURSE OBJECTIVES

1	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.
2	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.
3	To be familiar with various medical equipments.
4	To gain some practical experience in servicing the equipments.

COURSE OUTCOMES

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

CO1. Apply basic, industry-standard skills in routine and crisis situations in a general hospital setting and work effectively as a health care team member.	Apply
CO2. Use their effective communication skills by interacting with patients and other members of the healthcare team.	Apply
CO3. Infer modern engineering tools and techniques with their skill-set to solve different medical problems in healthcare society.	Analyze
CO4. Summarize the observations as report writing by following the standard procedures of medical screening.	Evaluate
CO5. Integrate the observations and formulating product design to emphasis better service on medical operations/ systems.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	--	S	L	--	S	--	--	S	M	S	M
CO2	S	M	L	--	--	S	L	--	S	--	--	S	M	S	M
CO3	S	S	M	S	S	S	M	--	S	--	--	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

- Students have to undergo two weeks practical training in biomedical equipments manufacturing companies or hospitals but with approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

- This course is mandatory and the student has to pass the course to become eligible for award of the degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.Nagappan	Professor & Principal	BME	principal.vmkvec@vmu.ac.in
2	Ms.B.Farhana Ansoor	Assistant Professor (G-I)	BME	farhanaansoor@avit.ac.in
3	Mr.S.Mathankumar	Associate Professor	BME	mathankumar@vmkvc.edu.in

17BMEC01	MEDICAL OPTICS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Medical optics is a branch of science uses light as an electromagnetic wave, similar to X-rays, microwaves, and radio waves, which is used as an investigational technique for medical applications. Examples include optical microscopy, spectroscopy, endoscopy, scanning laser ophthalmoscopy and optical coherence tomography.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To learn about properties of light and its application
2	To study various instruments in photonics
3	To understand the applications of laser
4	To understand optical holography
5	To study optical tomography

COURSE OUTCOMES

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

CO1. Describe the optical properties of the tissues.	Understand
CO2. Apply laser in medical field for diagnosis and therapeutic application.	Apply
CO3. Analyze the various instruments used in photonics	Analyze
CO4. Categorize the various techniques for hologram construction.	Analyze
CO5. Illustrate optical tomogram.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	--	L	--	--	M	--	M	S
CO2	S	M	L	--	--	--	--	--	L	--	--	S	M	M	S
CO3	S	S	M	M	--	M	--	--	M	--	--	S	S	S	S
CO4	S	S	S	S	M	M	--	L	M	M	--	S	S	S	S
CO5	S	S	S	S	M	M	--	L	M	M	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

OPTICAL PROPERTIES OF THE TISSUES

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

INSTRUMENTATION IN PHOTONICS

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, LASERs, optical filters, polarisers, solid state detectors, time resolved and phase resolved detectors.

APPLICATIONS OF LASERS

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

OPTICAL HOLOGRAPHY

Wavefronts, Interference patterns, principle of hologram, optical hologram, applications.

OPTICAL TOMOGRAPHY

Optical coherence tomography, Elastography, Doppler optical coherence tomography, Application towards clinical imaging.

TEXT BOOK

1. Leon Goldman, M.D., & R. James Rockwell, Jr., **"Lasers in Medicine"**, Gordon and Breach, Science Publishers Inc., New York, 1971.

REFERENCE

1. Mark E. Brezinski., **"Optical Coherence Tomography: Principles and Applications"**, Academic Press, 2006.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
2	Ms.B.Farhana Ansoor	Assistant Professor (G-I)	BME	farhanaansoor@avit.ac.in
3	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in

17BMEC02	BIOTELEMETRY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE
To study the overall concept of a Biotelemetry system and the concept of signal transmission.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study the basic concepts and the principles used in a Telemetry system.
2	To study the building blocks used to make a electrical telemetry system.
3	To study the basic components of transmitting and receiving techniques.
4	To know about how optical fibers are used in signal transmission.
5	To understand the real time application in biotelemetry.

COURSE OUTCOMES

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

CO1. Discuss about the basic information about Telemetry system.	Understand
CO2. Describe the knowledge about design of Electrical Telemetry Systems.	Understand
CO3. Demonstrate the different types of modulation techniques.	Apply
CO4. Analyze the implementation of optical fibers in telemetry system.	Analyze
CO5. Validate the healthcare system using Telemetry system.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	L	--	M	M	M	M
CO2	M	--	--	--	--	--	--	--	--	L	--	M	M	M	M
CO3	S	--	L	L	--	L	--	--	M	M	--	S	M	S	M
CO4	S	M	L	L	M	M	L	M	M	S	--	S	S	S	S
CO5	S	S	M	L	M	S	M	M	S	S	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Fundamental concepts – Significance, Principle, functional blocks of Telemetry and Telecontrol system- Methods of telemetry – Electrical, Pneumatic, Hydraulic and Optical Telemetry – State of the art-Telemetry standards.

ELECTRICAL TELEMETRY
Electrical Telemetry – Current Systems – Voltage Systems – Synchro Systems – Frequency systems – Position and Pulse systems – Example of a landline telemetry system.

RADIO TELEMETRY SYSTEM
Block diagram of a Radio Telemetry system – Transmitting and receiving techniques – AM, FM, PM, Multiplexing and demultiplexing – Transmitting and receiving techniques – Digital coding methods – Advantages of PCM, PWM, PM, FSK – Delta modulation – coding and decoding equipment – Example of a radiotelemetry system.

OPTICAL TELEMETRY SYSTEM
Optical fibers for signal transmission – Sources for fiber optic transmission – Optical detectors – trends in fiber– optic device development – Example of an optical telemetry System.

APPLICATION OF BIOTELEMETRY
Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super specialty centers, Societal medico legal aspects, Networking (local, national & global).

TEXT BOOKS
1. D.Patranabis, **"Telemetry principles"**, Tata Mcgraw Hill Publishers.
2. Marilyn J. Field, **"Telemedicine: A Guide to Assessing Telecommunications for Health Care"**, National Academic Press, 1996.

REFERENCE
1. Charles J. Amlaner, David W. Macdonald, **"A Handbook on Biotelemetry and Radio Tracking"**, Pergamon Press; 1st Edition (January 1, 1980).

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs. S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in
2	Ms.R.Sandhiya	Assistant Professor (Gr-I)	BME	sandhiya@avit.ac.in

17BMEC03	BIOMETRIC SYSTEMS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course will introduce students to the fundamentals of biometric system development and evaluation, with an emphasis on the three primary visual modalities: face, fingerprint, voice and IRIS.

PREREQUISITE: 17BMCC10 – MEDICAL IMAGE PROCESSING AND ANALYSIS

COURSE OBJECTIVES

1	To know about the fundamentals of Biometric systems.
2	To understand the finger print principles and technology.
3	To study about the Iris recognition method.
4	To understand the Facial scan technologies, face Recognition-Representation and Classification.
5	To understand the voice scan technology, features and their models.

COURSE OUTCOMES

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

CO1. Describe the technologies of fingerprint, iris, face and speech recognition.	Understand
CO2. Discuss the general principles of design of biometric systems and the underlying trade-offs.	Understand
CO3. Demonstrate knowledge engineering principles underlying biometric systems.	Apply
CO4. Analyze design basic biometric system applications.	Analyze
CO5. Identify issues in the realistic evaluation of biometrics based systems.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	--	L	--	--	--	M	--	--	M	M	M	M
CO2	M	M	L	--	L	--	--	--	M	--	--	M	M	M	M
CO3	S	S	M	M	M	M	--	--	M	--	--	M	S	M	M
CO4	S	S	S	S	S	M	--	M	M	M	--	S	S	S	M
CO5	S	S	S	S	S	S	--	S	S	S	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BIOMETRIC FUNDAMENTALS

Key Biometric terms and Processes – Definitions-verification and identification – matching, Accuracy in Biometric Systems – False match rate - False nonmatch rate - Failure to enroll rate – Derived metrics - An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy.

FINGERPRINT IDENTIFICATION TECHNOLOGY
History, Components, Application of Fingerprints, The Technology- Finger Scan Strengths and Weaknesses, Criminal Applications, Civil Applications, Commercial Applications, Technology Evaluation of Fingerprint Verification Algorithms.

IRIS RECOGNITION
Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions.

FACE RECOGNITION
Introduction, Components, Facial Scan Technologies, Face Detection, Face Recognition-Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

VOICE SCAN
Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

TEXT BOOKS:

1. James Wayman & Anil Jain, **"Biometric Systems – Technology, Design and Performance Evaluation"**, Springer-verlag London Ltd, 2005, USA.
2. Sanir Nanavati, Michael Thieme, **"Biometrics Identity Verification in a Networked world"**, Wiley Computer Publishing Ltd, 2003, New Delhi.

REFERENCE:

1. John D. Wood word Jr., **"Biometrics",** Dream tech Press, 2003, New Delhi.

COURSE DESIGNERS

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1	Dr.D.Vinodkumar	Professor	BME	vinodkumar@vmkvec.edu.in
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17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To enable the students to acquire knowledge about the principles and applications of MEMS & Nanotechnology in Biomedical Industry.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the working principle of MEMS & Microsystems.
2	To understand the working of MOEMS Technology.
3	To give an insight to the microfluidic systems.
4	To give an insight to the Bio-MEMS & its application in healthcare.
5	To study about the biomedical Nanotechnology & its application in research domain.

COURSE OUTCOMES

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

CO1. Discuss the concepts of microfluidic systems.	Understand
CO2. Explain about the basics of working of MOEMS Technology.	Understand
CO3. Illustrate the working principle of MEMS & Microsystems.	Apply
CO4. Analyze the nanomaterial in various biomedical applications.	Analyze
CO5. Evaluate about the biomedical Nanotechnology & its application in research domain.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	L	--	--	M	--	M	M
CO2	M	--	L	--	--	--	--	--	L	--	--	M	--	M	M
CO3	S	M	M	--	--	--	--	--	M	--	--	S	M	S	M
CO4	S	S	M	L	M	M	M	M	M	--	--	S	M	S	S
CO5	S	S	S	M	M	S	M	S	M	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

MEMS & MICROSYSTEM

MEMS and Microsystems-Introduction-Typical MEMS and Microsystem Products-Application of Micro- system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation – MEMS with Microactuation – Micro-accelerators.

MICRO-OPTO ELECTROMECHANICAL SYSTEMS (MOEMS)

Fundamental principle of MOEMS Technology, Advantages - Light Modulators, Beam splitter – Micro-lens, Micro-mirrors - Digital Micro-mirror Device, Grating Light Valve, Optical Switch, Waveguide and Tuning

MICROFLUIDIC SYSTEMS

Microfluidics - Introduction and Fluid Properties, Applications of MFS-Fluid Actuation Methods - Electrophoresis, Dielectrophoresis, Electrowetting, Optoelectrowetting, Electro osmosis Flow, Electrothermal Flow, Thermocapillary Effect – Microfluidic Channel – Microdispenser – Microneedle - Microfilter

BIOMEMS

Introduction to BioMEMS, BioMEMS for Clinical Monitoring, Lab on a chip, DNA Sensors, E-Nose, E-Tongue, Microsystem approaches to PCR, MEMS based Implantable Drug Delivery System, Emerging, BioMEMS Technology.

BIOMEDICAL NANOTECHNOLOGY

Introduction to nanoscale phenomena, Nanoparticles - Nanomaterial characterization – XRD,SAXS,TEM,SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MRImaging, Nano-devicesin biomedical applications.

TEXT BOOKS:

1. Tai-Ran Hsu, **"MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering"**, John Wiley & Sons, 2nd Edition, 2008.
2. Nitaigour Premch and Mahalik, **"MEMS"**, Tata McGraw Hill, 2nd Reprint 2008.
3. Wanjun Wang & Steven A. Soper, **"BioMEMS – Technologies and applications"**, CRC Press, First Edition 2007.

REFERENCES:

1. Steven S. Saliterman, **"Fundamentals of BioMEMS & Medical Microdevices"**, International Society for Optical Engineering, 1st Edition 2006.
2. Gerald A Urban, **"BioMEMS"**, Springer, 1st Edition 2006.
3. Abraham P. Lee and James L. Lee, **"BioMEMS and Biomedical Nanotechnology"**, Volume-I, Springer, 1st Edition, 2006.

COURSE DESIGNERS

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17BMEC05	HOME MEDICARE TECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of the course on home medicare technology for biomedical engineering students is to outline the health care that can be made available at home along with recent digital and tele-health technologies.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To introduce the biomedical instruments that can be used at home.
2	To understand the skills required for home medicare for the elderly and the children.
3	To emphasize the need for home medicare system.
4	To learn the advances in healthcare technologies and wireless technology related to healthcare system.
5	To provide the advance medical technology in home medicare.

COURSE OUTCOMES

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

CO1. Describe the biomedical instruments that can be used at home.	Understand
CO2. Examine the healthcare technologies and wireless technology.	Apply
CO3. Analyze the skills required for home medicare for the elderly and the children.	Analyze
CO4. Summarize the organization and the need for home medicare system.	Evaluate
CO5. Develop the digital technical advancements with home medicare.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	L	--	--	--	L	--	--	--	M	--	M	M
CO2	S	M	M	L	L	--	--	M	L	L	--	M	--	M	M
CO3	S	S	M	M	L	M	--	M	M	M	--	S	M	M	S
CO4	S	S	S	M	M	S	--	S	S	M	--	S	M	S	S
CO5	S	S	S	S	M	S	--	S	S	M	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO HOME MEDICARE

Home health care, purpose, legal and ethical aspects, Organization of homecare system, Historical development of home care, Environmental influences on home care, Home care organization, Home care nursing practice, Role of home care nurse and orientation strategies, Infection control in home, Patient education in home.

WORKING WITH USERS
Basic human needs, communication and interpersonal skills, Caregiver observation, recording and reporting, confidentiality, Working with elderly, aged, Working with children, need for home care, Mobility transfers and ambulation, range of motion exercises, Skin care and comfort.

MEDICAL INSTRUMENTS AND DEVICES AT HOME
Medical devices at home and its implementation, Scope of market for home medical devices, Unique challenges to the design & implementation of hightech home care devices, Infant monitors, Medical alert services, Activity monitors.

DIGITAL HOME CARE
Video communication to support care delivery to independently living seniors, Establishing an infrastructure for telecare, Implementation of mobile computing in home care programs, Home medicare management by videophone, Continuous home care through wireless bio-signal monitoring system.

ADVANCES IN MEDICAL TECHNOLOGIES
Dynamic configuration of home services, Personalized ambient monitoring, Support for mental health at home, Multi model interaction and technologies for care at home, User centered design of technologies to support care at home.

TEXT BOOKS:
1. Robyn Rice, **"Home care nursing practice: Concepts and Application"**, Elsevier, 4th Edition, 2006.
2. Lodewijk Bos, **"Handbook of Digital Homecare: Successes and Failures"**, Vol.3, Springer, 2011.

REFERENCES:
1. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D,Bronzino, **"Clinical Engineering"**, CRC Press, 1st Edition, 2010.
2. KenethJ. Tumer, **"Advances in home care technologies"**, AT research series, Vol 31, 1st Edition, IOS press, 2012.

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17BMEC06	APPLIED NEURAL NETWORKS AND FUZZY LOGIC SYSTEMS IN MEDICINE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To understand about the basic concepts of Neural Networks and Fuzzy Logic and learn to design and use them for biomedical applications.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the basic concepts of artificial neural networks.
2	To study the various ANN Models.
3	To familiarize about the Self organizing maps and competitive networks.
4	To study the basic concepts of fuzzy Logic systems.
5	To apply the concepts of ANN and Fuzzy Logic in Biomedical applications.

COURSE OUTCOMES

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

CO1. Explain the basic concepts of artificial neural networks.	Understand
CO2. Discuss about basics of the fuzzy logic.	Understand
CO5. Apply the concepts of ANN and Fuzzy Logic in Biomedical applications.	Apply
CO4. Illustrate the artificial neural network models.	Analyze
CO3. Summarize Self organizing maps and competitive networks.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	--	--	--	M	--	M	M
CO2	M	--	--	--	-	L	--	--	--	--	--	M	--	M	M
CO3	S	--	S	M	--	M	--	M	M	--	--	S	M	M	S
CO4	S	M	S	S	M	M	--	M	M	--	--	S	S	M	S
CO5	S	S	S	S	M	M	--	S	S	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

ARTIFICIAL NEURAL NETWORKS - AN OVERVIEW
Neural Networks Basics-Biological Neural nets, Processing elements-Mc Culloh Pitts Model, Types of Learning, Network Parameters-Weights, Activation, Threshold Functions, Hebb Rule, Delta Rule, Perception learning Algorithm.

ARTIFICIAL NEURAL NETWORKS MODELS
Mapping, training of Feed forward networks-Perception, Mapping, training of Recurrent Networks-Hopfield Network, Radial Basis Function Network, Training of Feed Forward Back Propagation Network, Applications of BPN.

SELF ORGANIZING MAPS (SOM)
Self organizing maps-Pattern clustering, SOM-Topological Mapping, Kohonen"s SOM, K-means clustering algorithm, competitive models – Min, Max Net, Adaptive Resonance Theory (ART) – Introduction, Network and Processing in ART, Associative memory model.

INTRODUCTION TO FUZZY LOGIC
Fuzzy logic-Basic concepts -Fuzzy Vs Crisp set, Linguistic variables, Membership functions, Fuzzy IF-THEN rules, Variable inference techniques, De-fuzzification techniques, Basic fuzzy inference algorithm.

NEURAL NETWORK AND FUZZY LOGIC APPLICATIONS IN MEDICINE
Neural Networks in Biomedical Applications, Cancer, Cardiovascular Applications, Medical Image Analysis using neural networks, Fuzzy Logic Applications, Fuzzy Logic Controller, Neuro fuzzy systems – Applications in medicine.

TEXT BOOKS:

1. Mohamad H. Hassoun, **"Fundamentals of Artificial Neural Network"**, Cambridge, The MIT Press, 1st Edition, 1995.
2. Laurene Fausett, **"Fundamentals of Neural Networks: Architectures, Algorithms, and Applications"**, Pearson Education India, 3rd Edition, 2008.

REFERENCES:

1. C.M.Bishop, **"Pattern Recognition and Machine Learning"**, Springer-Verlag, 2006.
2. Timothy J. Ross, **"Fuzzy Logic with Engineering Applications"**, John Wiley and Sons, 2nd Edition, 1995.
3. B.Yegnanarayana, **"Artificial Neural Networks"**, Prentice Hall of India, 3rd Edition 2006.

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17BMEC07	TROUBLESHOOTING AND QUALITY CONTROL IN MEDICAL EQUIPMENTS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course on troubleshooting and quality control in medical equipments for biomedical engineering students is to provide knowledge about the troubleshooting of various equipments used in hospitals and quality standard of medical equipment.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the fundamental concepts of troubleshooting process and fault finding aids.
2	To diagnose the fault operation in digital integrated circuits.
3	To learn the standards and quality measures for medical systems.
4	To apply the troubleshooting procedures in various biomedical machines.

COURSE OUTCOMES

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

CO1. Describe the various quality measures & standards adapted for medical systems.	Understand
CO2. Apply the common troubleshooting procedures in electronic equipment.	Apply
CO3. Outline the medical device quality and regulation.	Analyze
CO4. Analyze the problems in biomedical equipment in hospitals when it is not working and provide a suitable solution.	Analyze
CO5. Evaluate the fault diagnosis in analog circuits and digital ICs.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	--	--	--	--	L	L	--	--	M	--	M	M
CO2	S	S	M	L	M	--	--	L	L	--	--	M	L	M	M
CO3	S	S	M	M	S	M	--	M	M	L	--	M	M	M	S
CO4	S	S	M	S	S	M	--	M	M	L	--	M	M	M	S
CO5	S	S	S	S	S	S	--	S	M	M	M	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTAL TROUBLESHOOTING TESTING PROCEDURES

Equipment failure and its causes, Functional block diagram of a troubleshooting system, Troubleshooting process & fault finding aids, Troubleshooting techniques and their correction action, Testing of active and passive components: resistor, capacitor, inductor, BJT, JFET & MOSFET.

FAULT DIAGNOSIS IN ANALOG & DIGITAL INTEGRATED CIRCUITS
Characteristics of ideal op-amps, typical op-amp based medical circuits, Fault diagnosis in op-amp circuits, Digital troubleshooting methods, Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator, Circuit board Troubleshooting.

BIOMEDICAL EQUIPMENT TROUBLESHOOTING
Troubleshooting- ECG Machine, EEG Machine, defibrillator, electrosurgical unit, anesthesia machine, autoclaves & sterilizers, endoscope, incubators, nebulizer, oxygen concentrators, sphygmomanometers, suction machine, X-ray machine.

MEDICAL DEVICE DESIGN QUALITY
Definition of quality, essence of quality, Quality operating system and the device life cycle, Evolution of quality, Business excellence: a value proposition, Health care quality.

DESIGN FOR SIX SIGMA AND MEDICAL DEVICE REGULATION
Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF), Medical device safety, medical device quality management systems requirements, Medical device regulation throughout the product development life cycle, Purpose of ISO 9001:2001&ISO 13485.

TEXT BOOKS:

1. KhandpurR S, **"Troubleshooting Electronic Equipment- Includes Repair & Maintenance"**, Tata McGraw Hill, 2nd Edition, 2009.
2. Basem S EL-Haik& Khalid S Mekki, **"Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness"**, John Wiley & Sons, 1st Edition, 2008.

REFERENCES:

1. Nicholas Cram & Selby Holder, **"Basic Electronic Troubleshooting for Biomedical Technicians"**, TSTC Publishing, 2nd Edition, 2010.
2. Dan Tomal& Neal Widmer, **"Electronic Troubleshooting"**, McGraw Hill, 3rd Edition, 2004.
3. World Health Organisation, **"Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment"**, Geneva, 1994.

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17BMEC08	EMBEDDED SYSTEMS IN MEDICAL APPLICATIONS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course on embedded systems in medical devices for biomedical engineering students is to impart knowledge in the design of embedded system for various medical devices.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	Attain knowledge on the basic concepts and the building blocks for embedded system.
2	Understand the hardware and software partitioning in embedded systems.
3	Gain knowledge about timers and memory organization of embedded systems.
4	Design a pulse oximeter using embedded tool.
5	Design a pacemaker using embedded tool.

COURSE OUTCOMES

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

CO1. Discuss about embedded processor, its hardware and software.	Understand
CO2. Apply and integrate theory and practical which has been studied to solve the engineering problems.	Apply
CO2. Illustrate functionality for medical system design in health care.	Analyze
CO1. Evaluate the design steps of the biomedical equipments.	Evaluate
CO3. Design pacemaker and pulse oximeter using embedded tool.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	--	L	L	--	--	--	--	--	M	M	M	M
CO2	S	M	M	L	M	L	L	--	--	--	--	M	M	S	M
CO3	S	S	S	M	M	M	M	--	L	--	--	M	S	S	S
CO4	S	S	S	S	S	S	M	S	M	--	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	--	M	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

EMBEDDED DESIGN WITH MICROCONTROLLERS

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

PARTITIONING DECISION

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.

FUNCTIONALITIES FOR SYSTEM DESIGN

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.

DESIGN OF PATIENT MONITORING DEVICES

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.

DESIGNING OF PACEMAKER

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

TEXT BOOK

1. James K. Peckol, **"Embedded system Design"**, John Wiley & Sons, 1st Edition, 2010.

REFERENCES:

1. Elicia White, **"Making Embedded Systems"**, O'Reilly Series, SPD, 1st Edition, 2011.
2. G. Baura, **"A Biosystems Approach to Industrial Patient Monitoring and Diagnostic Devices"**, Morgan & Claypool, IEEE, 2008.

COURSE DESIGNERS

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17BMEC09	DESIGN OF MEDICAL DEVICES	Category	L	T	P	Credit
		EC-PC	3	0	0	3

PREAMBLE

This course will offer students exposure to the core concepts of the global medical device regulatory framework and provide a foundation for the practical application. It includes all elements of the device product lifecycle from idea to initial market entry, sustaining activities and post-market activities.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the post-marketing requirements associated with medical devices.
2	To understand the necessary steps to take an idea to a prototype.
3	To follow a deterministic engineering design process to create new products.
4	To apply engineering theory to practice.
5	To perform risk assessment and countermeasure development.

COURSE OUTCOMES

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

CO1.	Discuss the necessary steps to take an idea to a prototype.	Understand
CO2.	Utilize fundamental design principles, machine elements, manufacturing and assembly techniques.	Apply
CO3.	Analyze risk management concepts into the quality management system.	Analyze
CO4.	Assess the medical device regulatory framework for any given country based upon device type.	Evaluate
CO5.	Create potential regulatory pathway.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	M	--	--	M	--	M	M
CO2	S	M	--	--	--	--	--	--	M	--	--	M	M	M	M
CO3	S	M	M	L	--	M	--	L	M	--	--	S	M	M	M
CO4	S	S	M	M	M	S	--	M	S	--	M	S	S	S	M
CO5	S	S	S	M	M	S	--	M	S	--	M	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MEDICAL DEVICES AND MEDICAL DEVICE REGULATIONS

Medical Device Classification, Bioethics and Privacy, Biocompatibility and Sterilization Techniques, Design of Clinical Trials, Design Control & Regulatory Requirements.

INTRODUCTION TO SPECIFIC MEDICAL TECHNOLOGIES
Biopotential measurement (EMG, EOG, ECG, EEG), Medical Diagnostics (In-vitro diagnostics), Medical Diagnostics (Imaging), Minimally Invasive Devices, Surgical Tools and Implants.

MEDICAL DEVICES STANDARD AND INTELLECTUAL PROPERTY
Standard-ISO, IES, Intellectual Property - Patents, Copy rights, Trademarks, Trade secrets.

HARDWARE AND SOFTWARE DESIGN
Hardware design, Hardware risk analysis, Design and project merits, Design for six sigma, software design, software coding, software risk analysis, software metrics.

DESIGN TRANSFER AND MANUFACTURING
Transfer to manufacturing, hardware manufacturing, software manufacturing, configuration management, documents and deliverables.

TEXT BOOKS:

1. Richard Fries, **"Reliable Design of Medical Devices"**, CRC Press, 2nd Edition, 2006.
2. Paul H. King, Richard C. Fries, Arthur T. Johnson, **"Design of Biomedical Devices and Systems"**, Third Edition, ISBN 9781466569133.

REFERENCES:

1. John G. Webster (ed), **"Medical Instrumentation: Application and Design"**, 2007.
2. Peter J. Ogrodnik, **"Medical Device Design: Innovation from Concept to Market"**, Academic Press Inc; 1st Edition (2012), ISBN-10: 0123919428

COURSE DESIGNERS

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17BMEC10	BODY AREA NETWORKS AND MOBILE HEALTHCARE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To enable the students to gain knowledge in various aspects of BAN related to health and the techniques to apply these in proper health care delivery.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To Learn about body area network.
2	To study the different BAN hardware related to it.
3	To Provide knowledge in the applications of Body Area Networks.
4	To study the concept of telemedicine.
5	To Provide knowledge in the applications of Telemedicine.

COURSE OUTCOMES

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

CO1. Explain about concept of Body Area Network.	Understand
CO2. Describe about fundamentals of telemedicine.	Understand
CO3. Illustrate the applications of telemedicine & BAN in health care.	Apply
CO4. Analyze the Hardware for BAN in physiological system.	Analyze
CO5. Compare BAN and telemedicine.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	M	M	M
CO2	M	--	--	--	--	L	--	--	--	--	--	M	M	M	M
CO3	S	M	L	L	L	M	--	--	--	L	--	M	M	S	M
CO4	S	M	L	L	M	M	--	--	--	M	--	M	S	S	S
CO5	S	S	L	L	M	S	--	S	M	M	M	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Definition, BAN and Healthcare, Technical Challenges – Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture – Introduction.

HARDWARE FOR BAN

Processor – Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory, Antenna – PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources – Batteries and fuel cells for sensor nodes.

APPLICATIONS OF BAN

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

FUNDAMENTALS OF TELEMEDICINE

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

APPLICATIONS OF TELEMEDICINE

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

TEXT BOOK:

1. Annalisa Bonfiglio, Danilo De Rossi, **"Wearable Monitoring Systems"**, Springer, 2011.
2. Norris A C, **"Essentials of Telemedicine and Telecare",** John Wiley, New York, 2002.

REFERENCES:

1. Zhang, Yuan-Ting, **"Wearable Medical Sensors and Systems"**, Springer, 2013.
2. H K Huang, **"PACS and Imaging Informatics: Basic Principles and Applications"**, Wiley, New Jersey, 2010.
3. Guang-Zhong Yang (Ed.), **"Body Sensor Networks"**, Springer, 2006.
4. Mehmet R. Yuce,Jamil Y.Khan, **"Wireless Body Area Networks Technology, Implementation, and applications"**, Pan Stanford Publishing Pte.Ltd,Singapore, 2012.
5. Khandpur R S, **"Handbook of Biomedical Instrumentation"**, Tata McGraw Hill, New Delhi, 2003

COURSE DESIGNERS

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17BMEC11	NUCLEAR MEDICINE TECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE
To understand the fundamentals of Nuclear Medicine and learn about the instruments involved in production techniques and therapeutic uses of Nuclear Medicine.

PRERQUISITE: 17BMCC02 - HUMAN ANATOMY AND PHYSIOLOGY

COURSE OBJECTIVES

1	To learn the basics of nuclear medicine.
2	To study the construction and principle of operation of various nuclear medicine instruments.
3	To have some knowledge about the characteristics and mechanisms of radiopharmaceuticals.
4	To study the diagnostics and therapeutic applications of nuclear medicine.
5	To have idea about the radiation safety procedures and regulations.

COURSE OUTCOMES

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

CO1. Discuss the basics of radio activity.	Understand
CO2. Describe the construction and principle of operation of various nuclear medicine instruments.	Understand
CO3. Examine the characteristics and mechanisms of radiopharmaceuticals.	Apply
CO4. Illustrate the diagnostics and therapeutic applications of nuclear medicine.	Analyze
CO5. Assess the radiation safety and regulations.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	L	L	--	--	--	M	--	M	M
CO2	M	--	--	--	--	--	L	L	--	--	--	M	--	M	M
CO3	S	M	L	L	--	L	M	L	M	--	--	M	M	M	M
CO4	S	M	M	L	--	M	M	M	M	--	--	M	M	S	M
CO5	S	M	M	L	M	S	S	S	M	--	M	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF NUCLEAR MEDICINE
Radioactivity and interaction of radiation; Alpha, Beta and gamma emission, Laws of radioactive decay, Mechanisms of radioactive delay, Radiation intensity and exposure, Decay schemes and energy levels, Compton scattering, Pair productions, Particle interactions.

RADIOPHARMACEUTICALS

Radionuclide production, $^{99}Mo/^{99m}Tc$ generator, Mechanism of localization, Types of radiopharmaceuticals, characteristics of radio pharmaceuticals, Radiopharmaceuticals for diagnosis and treatments in human, Dispensing of radio pharmaceuticals, RIA radiopharmaceuticals and kits production.

NUCLEAR MEDICINE INSTRUMENTATION

Construction and principle operation of Gamma camera, Rectilinear scanner, Basic principles of pulse height analyser, Radiation detectors-Ionization chamber, Geiger Muller counter, Semiconductor detectors, Scintillation detectors, Electronic Instrumentation for radiation detection system.

DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF RADIONUCLIDE

PET-CT, Single photon emission computed tomography (SPECT), Radio iodine therapy for Thyrotoxicosis, Differentiated thyroid cancers, Palliative treatment for bone metastasis - 32P and 89 Strontium Dosage, Intravascular particulate radio nuclide Therapy, Receptor targeted therapy, 131I- MIBG Therapy, Targeted internal radiation in HCC: 90 Y, Radio-synovectomy using Yttrium.

RADIATION SAFETY

Radiation protection indifferent nuclear isotope therapy procedures, Management of radiation accidents, Radiation effect on pregnancy and fertility, Diagnosis, evaluation and treatment of radiation overexposure, Instruments used in radiation survey & monitoring, Handling of radioactive patients, Role of national and international bodies in radiation safety, ICRP recommendations, BARC regulations regarding limits of radiation exposure.

TEXT BOOKS

1. Simon Cherry, James Sorenson, Michael Phelps, **"Physics in NuclearMedicine",** Elsevier Saunders, 4th Edition, 2012.
2. Jennifer Prekeges, "**Nuclear Medicine Instrumentation"**, Jones and Barlett publishers, 1st Edition, 2011.
3. J. Harbert and A.F.G. Rocha, Lea and Fibiger, **"Textbook of Nuclear medicine"**, 2nd Edition, 2009.

REFERENCES

1. Max.H.Lombardi, **"Radiation safety in Nuclear Medicine",** CRC Press, Florida, USA, 2nd Edition 1999.
2. B.R. Bairi, Balvinder Singh, N.C. Rathod and P.V. Narurkar, **"Handbook of Nuclear medicine Instruments"**, Tata McGraw – Hill, 2nd Edition, 2010.
3. Ramesh Chandra, Lea and Febiger, **"Introductory Physics of Nuclear Medicine"**, American Association of physicists in medicine- Medical Physics, 3rd Edition, 2008.

COURSE DESIGNERS

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17BMEC12	HOSPITAL MANAGEMENT	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE
To provide the knowledge of planning, designing and safety management in hospital services.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To obtain the knowledge about the basic planning and organization of hospitals.
2	To study about the clinical and administrative services.
3	To impart knowledge on designing of hospital services.
4	To study and analyze the safety management in hospitals.
5	To study and analyze the infection control in hospitals.

COURSE OUTCOMES

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

CO1. Summarize the importance of hospital in healthcare and planning of hospital design.	Understand
CO2. Examine the various clinical services needed in the hospital.	Apply
CO5. Outline the implementation of various infection control techniques.	Analyze
CO4. Recommend the supporting services needed to build the hospital and safety guidelines.	Evaluate
CO3. Build the idea about the hospital services design.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	L	--	--	--	M	--	M	M
CO2	S	M	L	L	--	--	-	M	M	--	--	M	M	M	M
CO3	S	M	M	M	M	M	M	M	M	--	--	M	M	M	M
CO4	S	M	S	M	S	M	M	S	M	S	L	M	S	S	M
CO5	S	S	S	S	S	M	S	S	M	S	M	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

PLANNING AND ORGANIZATION OF THE HOSPITALS

Roles of hospital in healthcare – hospital planning and design-outpatient services the nursing unit – intensive care Unit – nursing services – effective hospital management – directing and leading – controlling – financial management.

CLINICAL AND ADMINISTRATIVE SERVICES

Radiology and imaging services – laboratory services – operation theatre suite pharmacy – central sterile supply department – hospital infection – materials management – evaluation of hospital services.

DESIGNING OF HOSPITAL SERVICES

Engineering department – maintenance management – clinical engineering electrical system – air conditioning system – water supply and sanitary system centralized medical gas system – communication system – solid waste management and transportation.

DESIGNING SUPPORT SERVICES AND SAFETY MANAGEMENT

Admitting department – medical records department – food service department laundry and linen service housekeeping – Volunteer department – safety in hospital fire safety – Alarm system – disaster management.

HOSPITAL INFECTION CONTROL

Importance of infection control – hand hygiene – aseptic techniques – isolation precautions – disinfection and Sterilization – clinical laboratory standards to infection control – health care workers safety.

TEXT BOOKS:

1. Kunders G D, **"Biomechanics: Hospitals, facilities planning and management"**, Tata Mcgraw Hill, 2008.
2. Sakharkar B M, **"Principles of hospital administration and planning"**, Jaypee Brothers Medical Publishers Pvt. Limited, 2nd Edition, 2009.

REFERENCE:

1. Sanjiv Singh, Sakthikumar Gupta, Sunil Kant, "**Hospital infection control guidelines, principles and practice"**, Jaypee Brothers Medical Publishers Pvt Limited, 1st Edition, 2012.

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17BMEC13	PRINCIPLES OF TISSUE ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The goal of tissue engineering is to replace or even improve biological tissues and their functions by the use of engineering methods and life sciences.The fast-moving fields oftissue engineering are considered to have transformative implications for futurebiomedical applications and the future health care. This course gives an overview on the current state intissue engineering, for example cell culture, molecular aspects, and engineering biomaterialswith additional focus on case study.

PRERQUISITE: NIL

COURSE OBJECTIVES

1	To understand about the different types of tissues.
2	To illustrate the aspects of cell culture.
3	To illustrate the molecular aspects in tissue engineering.
4	To outline thebiomaterials for tissue engineering.
5	To analyse the case study and regulatory issues in tissue engineering.

COURSE OUTCOMES

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

CO1. Explain the structure and organization of tissues.	Understand
CO2. Describe the different cell types andaspects of cell culture.	Understand
CO3. Apply the engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver.	Apply
CO4. Examine the case study in tissue engineering.	Apply
CO5. Analyze the molecular aspects in tissue engineering.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	--	M	M	M
CO2	M	--	--	--	--	--	--	--	--	--	--	--	M	M	M
CO3	S	S	--	--	--	M	--	--	M	--	--	M	M	S	M
CO4	S	M	M	--	--	M	--	--	M	--	--	M	S	S	M
CO5	S	M	--	S	--	M	L	L	M	--	--	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

CELL CULTURE
Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspects of cell Culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

MOLECULAR BIOLOGY ASPECTS
Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

SCAFFOLD AND TRANSPLANT
Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, hepatopoiesis.

CASE STUDY AND REGULATORY ISSUES
Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK:
1. Robat Lanza and Robert Langer, **“Principles of Tissue Engineering”**, Elsevier, 2007.

REFERENCES:
1. Bernhard O. Palsson, Sangeeta N. Bhatia, **“Tissue Engineering”**, Pearson Publishers 2009.
2. Ed. Joseph D. Bronzino, **“The Biomedical Engineering Hand Book”**, Second Edition, CRC Press LLC, 2000.

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17BMEC14	RADIOLOGICAL EQUIPMENTS	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

To get the clear understanding of X-ray generation, radio isotopes and various techniques used for visualizing the organs.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study about the functioning of X-ray tubes and scattered radiation and method by which fogginess can be reduced.
2	To study about the different types radio diagnostic unit, transverse tomography and types of radio detection.
3	To know the concepts of MRI functionality and imaging various sections of body.
4	To study about the different types of radiation detectors and various organ functions.
5	To understand human radiobiology.

COURSE OUTCOMES

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

CO1. Describe the working principle of X-ray machine and its application.	Understand
CO2. Examine the technique used for visualizing various sections of the body using magnetic resonance imaging.	Apply
CO3. Demonstrate the applications of radio nuclide imaging.	Apply
CO4. Illustrate the principle and working of computed tomography.	Analyze
CO5. Outline the effects of radiation.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	--	--	--	L	M	M	M
CO2	S	M	L	--	--	L	--	--	M	--	--	M	M	M	M
CO3	S	M	L	--	--	L	--	--	M	--	--	M	M	M	M
CO4	S	M	M	M	M	M	--	M	M	--	--	S	M	S	M
CO5	S	M	M	M	M	M	L	M	M	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

X – RAYS

Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, dental X- ray units.

COMPUTER TOMOGRAPHY

Basic Principles of computed tomography, CT Number, System Components- Scanning Systems, Processing system, Viewing system, Storage System. Computerized Axial Tomography, Types of Detectors, image reconstruction techniques – back projection and iterative method, Spiral CT, Transverse Tomography.

MAGNETIC RESONANCE IMAGING

Principle of NMR imaging system, Relaxation processes T1 and T2, Pulse Sequence, Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils MR Spectroscopy, Functional MRI. Biological effects and advantages of NMR imaging system.

NUCLEAR MEDICAL IMAGING SYSTEM.

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, Pulse Height Analyzer, Uptake Monitoring Equipment, Radio-Isotope Rectilinear Scanner, Gamma Camera, Multi-Crystal Gamma Cameras, ECE, SPECT, PET Scanner.

HUMAN RADIOBIOLOGY

Stochastic Effects Of Radiation, Nonstochastic Effects Of Radiation, Dosimetry In Individuals & Populations, Background Radiation Human Populations That Have Been Exposed To Unusual Levels Of Radiation, Dose-Effect Models, Factors That Influence Dose-Effect Models, Estimating Risks Of Radiation, Source Of Information.

TEXT BOOKS:

1. Steve Webb, **"The Physics of Medical Imaging"**, Adam Hilger Philadelphia, 1988.
2. R. S. Khandpur, **"Handbook of Biomedical Instrumentation"**, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.
3. William R. Hendee, E. Russel Ritenour, **"Medical Imaging Physics"**, Third Edition, Mosby Year Book, St. Louis, 1992

REFERENCES:

1. Chesney D.N and Chesney M.O., **"X-Ray Equipments for Students Radiographer"**, Blackwell Scientific Publications, Oxford, 1971.
2. Jacobson B. and Webster J.G., **"Medicine and Clinical Engineering"**, Prentice Hall India, New Delhi, 1999.
3. Alexander, Kalender and Linke, **"Computer Tomography"**, John Wiley, Chichster, 1986**.**

COURSE DESIGNERS

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17BMEC15	APPLIED OPTOELECTRONICS IN MEDICINE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course on applied optoelectronics in medicine for biomedical engineering students is to attain adequate knowledge about light sources, optical detectors, display devices and applications of optoelectronic devices in medicine.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study about the major light sources in laser and LED.
2	To learn the principles and operation of optoelectronic modulators.
3	To apply the sensor and detector in various optoelectronic detection methods.
4	To understand the construction and working of display devices.
5	To learn the applications of optoelectronic in medicine.

COURSE OUTCOMES

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

CO1. Explain the principles of light emission in LED and LASER.	Understand
CO2. Describe the working principles of optoelectronic modulators.	Understand
CO3. Use the optoelectronic sensors in medical devices.	Apply
CO4. Demonstrate the working of display devices.	Apply
CO5. Illustrate the optoelectronic modulators and detectors.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	L	--	L	--	--	--	M	--	M	M
CO2	M	L	--	-	--	L	--	L	--	--	--	M	--	M	M
CO3	S	M	M	L	--	M	--	L	M	--	--	M	M	S	M
CO4	S	M	M	L	--	M	--	M	M	--	--	M	M	S	M
CO5	S	M	S	M	M	M	--	M	M	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

LIGHT SOURCES

LASER: characteristics, population inversion, Pumping schemes: optical pumping, electrical pumping and direct pumping schemes, Two level, three level and four level laser principle with energy level diagram, Optical resonator configuration in laser, Threshold condition for laser, LED: construction, working principle, LED materials.

OPTOELECTRONIC MODULATOR
Basic principles, Analog and digital modulation, Electro-optic modulators, Magneto optic devices, Acousto-optic devices, Optical switching.

OPTOELECTRONIC DETECTION METHODS
Thermal detectors: bolometer, pyroelectric detector, Photodiode: principle of operation, V-I characteristics, Types of photodiode: avalanche photodiode, PIN photodiode: construction, operating principle, applications, Phototransistor: construction, operating principle, applications, Photomultiplier tube: construction, operating principle, applications, Solar cell: construction, operating principle, applications, Optocouplers: construction, operating principle.

DISPLAY DEVICES
Photo luminescence, Cathode luminescence, Electro luminescence, Numeric displays: common cathode and common anode, LCD display: liquid crystals, construction and types, Plasma display: construction and working principle, Color plasma display: construction and working principle, Nixie tube.

MEDICAL APPLICATIONS OF OPTOELECTRONIC DEVICES
X ray and nuclear radiation sensors, Fiber optic blood pressure sensor, Optical fiber based respiration sensor for non-invasive respiratory monitoring, Non-invasive blood pressure and SPO2 measurement devices.

TEXT BOOKS:

1. Wilson J and Hawkes J.F.B, **"Optoelectronics – An Introduction"**, Prentice Hall of India Pvt. Ltd., New Delhi, 3rd Edition, 2003.

REFERENCES:

1. Safa O Kasap, **"Optoelectronics and Photonics: Principles and practices"**, PHI, 1st Edition, 2009.
2. Bhattacharya, **"Semiconductor Optoelectronic Devices"**, Prentice Hall of India Pvt., Ltd., New Delhi, 2nd Edition, 1997.
3. Jasprit Singh, **"Optoelectronics – As Introduction to materials and devices"**, McGraw-Hill International Edition, 1st Edition, 1996.
4. K Thyagarajan, A K Ghatak, **"Lasers: theory and applications"**, Plenum publishing corporation, 2006.

COURSE DESIGNERS

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17BMEC16	THERAPEUTIC & SURGICAL EQUIPMENTS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To make the students aware of various therapeutic and surgical equipment's in use and to ensure the students to use the Therapeutic equipment in a safe and effective manner.

PREREQUISITE: 17BMCC04 – BIOMEDICAL INSTRUMENTATION & MEASUREMENTS

COURSE OBJECTIVES

1	To acquire an adequate knowledge about the need of cardiac pacemakers and defibrillators.
2	The fundamental principle and working of the biomedical surgical instruments.
3	It deals with artificial kidney.
4	It provides the knowledge about Anesthesia machine and X-ray machine.
5	Enable the students to understand the Artificial respiration.

COURSE OUTCOMES

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

CO1. Describe the working of pacemaker and Defibrillators.	Understand
CO2. Illustrate the types of diathermy and its applications.	Apply
CO3. Demonstrate the haemodialysis machine.	Apply
CO4. Outline the need of Anesthesia machine and X-ray machine.	Analyze
CO5. Analyze the parameters related to respiratory system.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	--	--	--	--	M	--	M	M
CO2	S	L	--	--	--	L	--	--	L	--	--	M	M	M	M
CO3	S	M	L	L	--	M	--	--	L	--	--	M	M	M	M
CO4	S	S	M	M	L	M	--	L	M	--	--	S	M	M	M
CO5	S	S	M	M	M	M	--	M	M	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INSTRUMENTS FOR CARDIOLOGY

Cardiac Pacemakers - Need for Cardiac Pacemaker - External Pacemakers - implantable Pacemakers – Recent evelopments in Pacemaker system analyzer. Cardiac Defibrillators -Need for a Defibrillator - DC Defibrillator - Implantable Defibrillators - Pacer-cardio vector - defibrillator analysis.

INSTRUMENTS FOR SURGERY

Instruments for surgery - principle of surgical diathermy - surgical diathermy machine - safety aspects in Electro-Surgical diathermy Units. Physiotherapy and electrotherapy equipment - High frequency heat therapy – short wave Diathermy - Microwave diathermy - Ultrasonic therapy unit - Pain relief through Electrical Stimulation - Bladder Stimulators - cerebellar Stimulators.

HAEMODIALYSIS

Haemodialysis Machines - Function of the kidneys - Artificial Kidney - Dialyzers - Membrances of haemodialyzers - Portable Kidney machines. Lithotripters - The stone disease problem - First lithotripter machine - modern lithotripter systems - Extracorporeal Shockwave Therapy.

PULMONARY AND RADIOTHERAPY INSTRUMENTS

Anesthesia Machine - Need for Anesthesia - Anesthesia machine - Electronics in Anesthesia machine. Radiotherapy Equipment - Development of Betatron, chemotherapy, Heart lung Machine.

VENTILATORS

Ventilators: Mechanics of Respiration - Artificial Respiration - Ventilators - Types of ventilators - Classification of Ventilators - Pressure - volume - flow Diagrams - Modern ventilators - High frequency ventilators. Humidifiers - Nebulizers and Aspirators.

TEXT BOOK

1. R. S. Khandpur, **"Handbook of biomedical Instrumentation"**, Tata McGraw Hill Publication company Ltd, NewDelhi, 1997.

REFERENCE BOOK

1. Joseph J. Carr, John Michael Brown, **"Introduction to Biomedical Equipment Technology"**, 4th Edition, Pearson Education, 2001.
2. John G. Webster, **"Biomedical Instrumentation"**, Wiley Publications.2007.

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17BMEC17	MEDICAL IMAGING TECHNIQUES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE
To study the image reconstruction techniques in different equipment like CT scan, Ultrasound Scanner, MRI, Endoscope, X-ray machine.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study the quality assurance test for radiography, method of recording sectional images.
2	To learn the functioning of radio isotopic imaging equipments.
3	To understand the MRI, image acquisition and reconstruction.
4	To study the 3-D image display techniques.
5	To analyze the imaging systems thermography.

COURSE OUTCOMES

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

CO1. Describe the layout of infrared imaging.	Understand
CO2. Explain the basic concepts of radio isotopic imaging.	Understand
CO3. Apply X-ray equipment for imaging.	Apply
CO4. Analyze CT-scan and MRI machine.	Analyze
CO5. Outline the different types of ultrasound scan.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	L	--	L	--	--	--	--	--	L	--	M	M
CO2	M	--	--	L	--	L	--	--	M	-	--	L	--	M	M
CO3	S	M	L	M	M	M	--	L	M	--	--	M	M	S	M
CO4	S	M	L	M	M	M	--	L	M	--	--	M	S	S	S
CO5	S	M	L	M	M	M	--	L	M	--	--	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

ULTRASOUND IN MEDICINE

Production of ultrasound – properties and principles of image formation, capture and display – principles of A-mode, B-mode and M-mode display – Doppler ultra sound and colour flow mapping – applications of diagnostic ultra sound.

X-RAY COMPUTED TOMOGRAPHY

Principles of sectional imaging – scanner configuration – data acquisition system – image formation principles – conversion of x-ray data in to scan image – 2-D image reconstruction techniques – Iteration and Fourier method – types of CT scanners.

MAGNETIC RESONANCE IMAGING

Principles of MRI pulse sequence – image acquisition and reconstruction techniques – MRI instrumentation magnetic gradient system RF coils – receiver system functional MRI – Application of MRI.

RADIO ISOTOPIC IMAGING

Rectilinear scanners – linear scanners – SPECT – PET Gamma camera radio nuclides for imaging – emission computed CT.

INFRA RED IMAGING

Physics of thermography – imaging systems – pyroelectric vidicon camera clinical thermography – liquid crystal thermography.

TEXT BOOK:

1. Steve Webb, **“The physics of medical imaging”**, Adam Hilger, Bristol, England, Philadelphia USA, 1988.

REFERENCES:

1. C. Kak, **“principles of computed tomography”**, IEEE press, Newyork.
2. G. A. Hay, **“Medical Image formation perception and measurement”**.
3. Divyendu Sinha & Edward R.Dougherty, **“Introduction to Computer Based Imaging Systems”**, PHI, 2003.

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17BMEC18	ARTIFICIAL INTELLIGENCE & PATTERN RECOGNITION	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE
It is to provide an adequate mastery of technical current trends in Artificial Intelligence and pattern recognition

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To Educate on the basic concepts of Artificial Intelligence.
2	To learn about the basic problem solving skills in AI.
3	To Study the principles of pattern Recognition techniques and the analysis.
4	To Introduce The Basics of Decision Making.
5	To Introduce the application of pattern recognition in medicine.

COURSE OUTCOMES

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

CO1. Explain the basic Concepts of artificial intelligence.	Understand
CO2. Examine the problem solving skills in AI.	Apply
CO3. Demonstrate the principles of pattern Recognition techniques and the analysis.	Apply
CO4. Categorize the Decision Making.	Analyze
CO5. Outline the cluster analysis and feature extraction.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--		--	--	--	L	--	--	M	--	M	M
CO2	S	M	L	--	L	--	--	--	L	--	--	M	M	M	M
CO3	S	M	L	--	L	--	--	--	L	--	--	M	M	M	M
CO4	S	M	M	L	M	L	--	--	M	--	--	S	S	M	S
CO5	S	M	M	L	M	L	--	--	M	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Definition of AI, Intelligent agents, perception and language processing, problem solving, searching, heuristic searching, game playing, Logics, logical reasoning.

BASIC PROBLEM SOLVING METHODS

Forward Vs Background, knowledge representation, frame problems, heuristic functions, weak methods of matching.

PRINCIPLES OF PATTERN RECOGNITION

Patterns and features, training and learning in pattern recognition, pattern recognition approach, different types of pattern recognition.

DECISION MAKING

Baye's theorem, multiple features, decision boundaries, estimation of error rates, histogram, kernels, window estimaters, nearest neighbor classification, maximum distance pattern classifier, adaptive decision boundaries.

CLUSTER ANALYSIS AND FEATURE EXTRACTION

Unsupervised learning, hierarchical clustering, Graph theories approach to pattern clustering, fuzzy pattern classifier, application of pattern recognition in medicine.

TEXT BOOKS

1. Elain Rich and Kevin Knight, **"Artificial Intelligence"**, 3rd Edition, Tata McGraw- Hill, 2009.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, **"Pattern Recognition and Image Analysis"**, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

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17BMEC19	PICTURE ARCHIVING AND COMMUNICATION SYSTEMS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course on Picture Archiving and communication systems for biomedical engineering students is to acquire knowledge on the fundamental concepts, networking technology and its broad application in healthcare system.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the basics of picture archiving and communication system.
2	To learn about the image display devices and workstations.
3	To know the Networking Technologies.
4	To understand the Data Storage.
5	To learn about the Healthcare Information Integration, Practical PACS Implementation and Applications.

COURSE OUTCOMES

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

CO1. Explain the basic fundamental concepts of picture archiving and communication system.	Understand
CO2. Describe the types of workstations and image display devices.	Understand
CO3. Apply the concept of PACS in networking technologies.	Apply
CO4. Outline the data storage process of PACS.	Analyze
CO5. Illustrate the healthcare integration, implementation and its applications.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	--	--	--	M	--	M	M
CO2	M	--	--	--	--	L	--	--	--	--	--	M	--	M	M
CO3	S	L	L	--	--	L	--	--	L	L	--	M	--	M	M
CO4	S	M	L	--	M	M	--	--	L	L	--	S	M	M	S
CO5	S	M	L	--	M	M	--	--	L	L	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

PACS: THE TRANSITION TO MEDICINE AND SERVERS
History of Picture archiving and communication system, (PACS): Computer network development and data storage technology history, Establishment of standards for image exchange in medicine, Imaging modality digitization, defining PACS: from mini to enterprise, Advantages and benefits, work flow changes after implementation of PACS, Prerequisites for PACS implementation, PACS server.

IMAGE DISPLAY DEVICES AND WORKSTATIONS
Softcopy image display system, quality standards for display devices, Types of image display workstations, Workstation architecture, environment for PACS workstations, Radiology workflow, Speech recognition for report dictation.

NETWORKING TECHNOLOGIES
Ethernet local area network, Wide area network, Network topology, Wi-Fi and wireless local area network, Network security.

DATA STORAGE
Data storage media types, Digital storage device interface, Image data compression, content-addressed storage, Short-term and long-term storage.

HEALTHCARE INFORMATION INTEGRATION, PRACTICAL PACS IMPLEMENTATION AND APPLICATIONS
Health Level 7: HL7 Version 2.X, 3.X, DICOM, Integrating the healthcare enterprise technical frameworks, PACS equipment selection and contract preparation Application review on: cardiology PACS, pathology PACS, Radiation oncology PACS, endoscopy PACS, Other applications of PACS.

TEXT BOOKS:

1. Yu Liu, Jihong Wang, **“PACS and Digital Medicine: Essential Principles and Modern Practice”**, CRC Press, 1st Edition, 2010.
2. Keith J, Dreyer D, **“PACS A Guide to the Digital Revolution”**, Springer, 2nd Edition, 2006.

REFERENCES:

1. H.K.Huang, Wiley-Blackwell **“PACS and Imaging Informatics: Basic Principles and Applications”**, Wiley-Blackwell, 2nd Edition, 2004.
2. homas D. Vreugdenburg , Cameron D. Willis, Linda Mundy, Janet E. Hiller, **“A systematic review of elastography, electrical impedance scanning, and digital infrared thermography for breast cancer screening and diagnosis”**, Breast Cancer Research and Treatment, Springer**,** 2013.

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17BMEC20	HOSPITAL INFORMATION SYSTEMS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

With an objective of imbibing a professional approach amongst students towards hospital management. The subject encompasses management principles, staffing and marketing processes, discussing their significance and role in effective and efficient management of health care organizations.

PREREQUISITE:NIL

COURSE OBJECTIVES

1	To understand the hospital information system and supporting service.
2	To study the hospital management information systems.
3	To know about the concepts of staffing process.
4	To study the concept of marketing and management.
5	To plan the maintenance of records in the other supportive departments of hospital.

COURSE OUTCOMES

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

CO1. Explain the information system of hospital & supporting service.	Understand
CO3. Discuss the various concept of staffing process.	Understand
CO4. Describe the concept of marketing and management.	Understand
CO5. Utilize computer to maintenance of records in the other supportive departments of hospital.	Apply
CO2. Analyze the principle of hospital management.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	L	--	--	M	--	M	M
CO2	M	--	--	--	--	L	--	--	L	--	--	M	--	M	M
CO3	M	--	--	--	-	L	--	--	L	--	--	M	--	M	M
CO4	S	L	--	--	--	M	--	--	L	--	--	M	--	M	M
CO5	S	M	--	--	--	M	--	--	L	--	--	M	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES

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.

PRINCIPLE OF HOSPITAL MANAGEMENT

Importance of management and Hospital, Management control systems. Forecasting techniques decision - making process.

STAFFING

Staffing pattern in hospitals, Selection, Recruiting process, Training of staff, Organizational structures, Career development

MARKETING AND MANAGEMENT

Basic concepts marketing, Principles of social marketing, Social marketing in health sector, Consumer behavior and research health, Advertising in Health Sector, Relevance of e-marketing of Health care services

COMPUTER IN HOSPITAL

System Development life cycle, Reasons to use computers in hospital, main categories of information systems in hospitals

TEXT BOOKS:

1. Goyal R.C., **"Human Resource Management in Hospital"**, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. G.D.Kunders, **"Hospitals – Facilities Planning and Management"** – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:

1. Nauhria R.N. and Rajnish Prakash, **"Management & systems"**, New Delhi Wheeler publishing, 1995.
2. Koontz, **"Essentials of Management"**, McGraw Hill, 1995.

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17BMEC21	MEDICAL SIMULATION IN LIFE SUPPORTING DEVICES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of the course on medical simulation and life supporting device for biomedical engineering students is to get practical knowledge in operating basic life supporting devices under emergency condition.

PREREQUISITE:NIL

COURSE OBJECTIVES

1	To understand the structure and function of heart and brain.
2	To learn the various techniques available for deployment in patient suffering from respiratory emergency.
3	To operate and trouble shoot mechanical ventilator in a patient.
4	To provide hands on training on life supporting instruments.
5	Explain the use of ultrasound in critical cardiovascular and respiratory diseases and trauma diagnosis.

COURSE OUTCOMES

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

CO1. Explain anatomy and physiology of the heart and demonstrate various lifesaving technique used under cardiac arrest	Understand
CO2. Describe various techniques available for deployment in patient suffering from respiratory emergency	Understand
CO3. Illustrate the Initiate, operate and troubleshoot the ventilator.	Apply
CO4. Outline various arrhythmias that can be treated by life supporting device and approach algorithmically towards management of these patients	Analyze
CO5. Analyze life supporting devices	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	L	L	--	L	--	M	L	--	--	L	--	M	M
CO2	M	--	L	L	--	L	--	M	L	--	--	L	--	M	M
CO3	S	M	M	M	M	M	--	M	M	--	--	M	M	M	S
CO4	S	M	M	S	M	M	--	M	S	--	--	M	M	S	S
CO5	S	M	M	S	M	S	--	M	S	--	--	M	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC LIFE SUPPORT
Anatomy and physiology of heart, Cardiogenic shock complicating acute coronary syndrome, CPR practice using mannequin, AHA BLS guidelines and practice, Automatic external Defibrillator, Defibrillator practice and troubleshooting.

ANALYZING ARRHYTHMIAS FOR LIFE SUPPORT
Description of ECG arrhythmias-an overview, Tachycardia and Bradycardia algorithm and practice, ECG arrhythmia simulator and practice, ACLS guidelines and practice using mannequins.

BASIC AIRWAY MANAGEMENT
Ventilation failure and oxygenation failure, Inserting airway adjunct (OPA – Oropharyngeal airway and NPA - Nasopharyngeal airway), Oxygen therapy, LMA and insertion Technique, AMBUBAG indication and practice.

VENTILATOR FOR LIFE SUPPORT
Basic anatomy of lung and mechanism of breathing, Mechanical ventilator history and classification, Pressure –volume flow diagram, Different modes of ventilator, Ventilator alarm and trouble shooting, Indication and disease specific ventilation, Weaning from ventilator.

ROLE OF ULTRASOUND IN LIFE SUPPORT
Basic principle of ultrasound and different modes of display, Different transducers used in ultrasound, Ultrasound doppler blood flow meter, Ultrasonography in emergency cardiovascular care, Lung ultrasound, Fast scan.

TEXT BOOKS:

1. Arthur C. Guyton, John Edward Hall, **"Textbook of Medical Physiology"**,13th Edition Elsevier Inc 2016.
2. John M. Field, Peter J. Kudenchuk, Robert O'Connor, Terry Vanden Hoek, **"The Textbook of Emergency Cardiovascular Care and CPR"**, lippinocot William and wilkins, 1st Edition, 2009.
3. James G. Adams, **"Emergency Medicine: Clinical Essentials"**, Saunders an imprint of Elsevier Inc, 2nd Edition, 2013.
4. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata Mc Graw Hill, 2nd Edition, 2003.

REFERENCES:

1. Peter Papadakos, Burkhard Lachmann, **"Mechanical Ventilation: Clinical Applications and Pathophysiology"**, sunders an imprint of Elsevier, 1st Edition 2008.
2. Ashfaq Hasan ,**"Understanding Mechanical Ventilation: A Practical Handbook"**, Springer verlag London limited, 2nd Edition 2010.
3. Matthias Hofer, **"Ultrasound Teaching Manual: The Basics of Performing and Interpreting"**, thieme newyork Stuttgart, 3rd Edition, 2013.

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17BMEC22	MEDICAL ETHICS AND STANDARDS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To enable the students to acquire knowledge about the medical standards, ethics medicine and drugs acts, Drugs and cosmetics standards and various medical acts.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To enable the students to understand the medical ethics.
2	To analyze medical standards.
3	To study the medicine and drug acts.
4	To learn about drugs and cosmetics standards.
5	To learn about various medical laws.

COURSE OUTCOMES

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

CO1. Explain the basic principle of medical ethics.	Understand
CO2. Discuss the various medical standards.	Understand
CO3. Describe the Medicine and drug related acts.	Understand
CO4. Illustrate about drugs and cosmetics standards.	Apply
CO5. Outline the various medical Laws.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	--	--	--	--	L	--	M	--	--	--	M	--	M	M
CO2	L	--	--	--	--	L	--	M	--	--	--	S	--	M	M
CO3	L	--	--	--	--	L	--	M	--	--	--	S	--	M	M
CO4	M	--	--	--	--	M	--	S	L	--	--	S	--	M	S
CO5	M	--	--	--	--	M	--	S	M	--	--	S	--	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

MEDICAL ETHICS

Introduction - Medical ethics, Code of conduct, Basic principles of medical ethics, Autonomy and informed consent, Organ transplantation, Medico legal aspects of medical.

MEDICAL STANDARDS

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

MEDICINE AND DRUGS ACTS

Narcotics and Psychotropic substances Act, Drugs and Magic remedies (Objectionable advertisement) Act 1954, Poisons act 1919 – Patent Act – Intellectual Property Rights.

DRUGS AND COSMETICS STANDARDS

Medicinal and Toilet preparations (Excise duties) Act and rules, Drugs Price control order, Shops & Establishments Act, Sales promotion employees (conditions of service) Act.

MEDICAL ACT

Medical Termination of Pregnancy Act, Prevention of cruelty to Animals act, Insecticides Act. Consumer protection Act 1986 - The Factories Act 1948 and the Amendment (salient features).

TEXT BOOKS

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. K. Jain,**"Forensic Pharmacy"**, 6th Edition, CBS Publishers. Delhi
4. 4K. Ram Kumar,**"Forensic Pharmacy and Pharmaceutical Business Management"**, 1st Edition, 2006

REFERENCES

1. G. Vidyasagar & T. V. Narayana,**"Forensic Pharmacy"**, Kalyani Publishers, New Delhi.
2. Vijay Malik,**"Drugs and Cosmetics Act, 1940"**, Eastern Book Company, Lucknow.

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17BMEC23	TELE HEALTH TECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To enable the students to acquire knowledge about the telemedicine, type of information & communication infrastructure for telemedicine, medical ethics and legal aspects of telemedicine.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To Learn the key principles for telemedicine and health.
2	To Understand the telemedical technology.
3	To Know about telemedical standards, mobile telemedicine and it applications.

COURSE OUTCOMES

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

CO1. Discuss about fundamentals of telemedicine.	Understand
CO2. Describe the ethical and legal aspects of telemedicine.	Understand
CO3. Apply multimedia technologies in telemedicine.	Apply
CO5. Examine the telehealth in healthcare.	Apply
CO4. Analyze the encryption techniques for secure transmission of data.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	L	--	--	M	--	M	M
CO2	M	--	--	--	--	L	--	M	L	--	--	M	--	M	M
CO3	S	M	M	L	L	M	--	--	M	--	--	M	M	S	S
CO4	S	M	M	L	L	M	--	--	M	--	--	M	M	S	S
CO5	S	S	M	M	M	M	--	M	M	--	--	M	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF TELEMEDICINE
History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE
Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE
Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

PICTURE ARCHIVING AND COMMUNICATION SYSTEM
Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

APPLICATIONS OF TELEMEDICINE
Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, eHealth and Cyber Medicine.

TEXTBOOKS:

1. Norris A C, **"Essentials of Telemedicine and Telecare"**, John Wiley, New York, 2002.
2. H K Huang, **"PACS and Imaging Informatics: Basic Principles and Applications"**, Wiley, New Jersey, 2010.

REFERENCES:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, **"Handbook of Telemedicine"**, IOS Press, Netherland, 2002.
2. Khandpur R S, **"Handbook of Biomedical Instrumentation"**, Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, **"Pacs: A Guide to the Digital Revolution"**, Springer, New York, 2002.
4. Khandpur R S, **"Telemedicine – Technology and Applications"**, PHI Learning Pvt. Ltd., New Delhi, 2017.

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17BMEC24	MACHINE LEARNING TECHNIQUES IN MEDICINE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course on machine learning techniques in medicine for biomedical engineering students is to provide an understanding of different machine learning techniques and to enable the students in solving problems in medicine.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Understanding the Basics of Machine learning.
2	To learn the techniques involved in Planning.
3	To understand the Decision Trees and Bayesian Networks.
4	To learn the Machine Learning Delivery and Motion Management in Radiotheraphy.
5	To understand the Hematological Cytology Applications through Machine Learning.

COURSE OUTCOMES

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

CO1. Explain the history, algorithm types, languages for machine learning.	Understand
CO2. Describe machine learning cycle with different data parameters.	Understand
CO3. Illustrate the knowledge of machine learning in radiotherapy.	Apply
CO4. Outline the decision trees and Bayesian networks.	Analyze
CO5. Analyze the methods to detect, classify and measure objects in hematological cytology.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	M	--	--	M	--	--	M	--	M	M
CO2	M	--	--	--	--	M	--	--	M	--	--	M	--	M	M
CO3	S	L	L	L	--	M	--	--	M	--	--	M	--	M	M
CO4	S	M	M	L	--	M	--	--	M	--	--	S	M	M	S
CO5	S	M	M	L	L	M	--	--	M	--	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

MACHINE LEARNING BASICS

Introduction – What is learning, History of machine learning, Algorithm types for machine learning, the human touch, Uses for machine learning, Languages for machine learning.

PLANNING FOR MACHINE LEARNING
Machine learning cycle, Defining the process, building a data team, Data processing, data storage, Data privacy, data quality and cleaning.

WORKING WITH DECISION TREES AND BAYESIAN NETWORKS
Basics of decision trees – uses, advantages and limitations, Different algorithm types and working of decision trees, Bayesian networks – little graph theory, little probability theory, Bayes theorem, working of Bayesian networks.

MACHINE LEARNING DELIVERY AND MOTION MANAGEMENT IN RADIOTHERAPHY
Method to emulate and compensate breathing motion during radiation therapy, Image-based motion correction, Detection and prediction of radiotherapy errors, Treatment delivery validation - recent advancements in radiotherapy application through machine learning.

HEMATOLOGICAL CYTOLOGY APPLICATIONS THROUGH MACHINE LEARNING
Automatic analysis of microscopic images in hematological cytology applications, Methods to detect, classify and measure objects in hematological cytology, Fully automated blood smear analysis system, Recent advances of main automated analysis steps in hematological cytology applications.

TEXT BOOKS

1. Issam E I Naqa., **"Machine Learning in Radiation Oncology - Theory and Applications"**, Springer, 1st Edition, 2015.
2. Jason Bell, **"Machine Learning for Big Data: Hands on for Developers and Technical Professionals"**, John Wiley & Sons, 1st Edition, 2014.
3. Cyran KA, Kawulok J, Kawulok M, Stawarz M, Michalak M, Pietrowska M, Polańska J., **"Support Vector Machines in Biomedical and Biometrical Applications. In Emerging Paradigms in Machine Learning"**, Vol.13, Springer, 2013.

REFERENCE BOOKS

1. Kenneth R Foster, Robert Koprowski, Joseph D Skufca, **"Machine learning, medical diagnosis, and biomedical engineering research – commentary"**, Journal of Biomedical Engineering, 2014.
2. Koprowski R, Zieleźnik W, Wróbel Z, Małyszek J, Stepien B, Wójcik W., **"Assessment of significance of features acquired from thyroid ultrasonograms in Hashimoto's disease"**, Journal of Biomedical Engineering Online, 2012.
3. David A. Rubenstein, Wei Yin, Mary D. Frame., **"Machine Learning and Data mining: Introduction to Principles and Algorithms"**, Horwood Publishing Ltd, 1st Edition, 2007.
4. Tom M Mitchell., **"Machine Learning"**, Mcgraw Hill Education, 1st Edition, 2007.
5. Igor Konenenko, MatzajKukar., "**Machine Learning and Data mining: Introduction to Principles and Algorithms"**, Horwood Publishing Ltd, 1st Edition, 2007.

COURSE DESIGNERS

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17BMEC25	ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The purpose of learning this course is to gain In-depth knowledge about the Ultrasound imaging systems and its interaction with living systems and ultrasonic scanning method for imaging different organs.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the principles of ultrasonic.
2	To know about the tissue ultrasound interaction.
3	To know about the various scanning techniques.
4	To learn the principles of real time scanners.
5	To know the various applications of ultrasound in medicine.

COURSE OUTCOMES

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

CO1. Describe the basic principles of ultrasonic.	Understand
CO2. Discuss the tissue ultrasound interaction.	Understand
CO3. Examine the various scanning techniques.	Apply
CO4. Outline the real time ultrasound scanners and color doppler.	Analyze
CO5. Illustrate the ultrasonic diagnosis and 3-dimensional ultrasound.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	--	--	--	L	--	M	M
CO2	M	--	--	--	--	L	--	--	--	--	--	L	--	M	M
CO3	S	L	L	--	M	M	--	--	M	--	--	M	M	M	S
CO4	S	M	M	L	M	S	--	--	M	--	--	S	M	S	S
CO5	S	M	M	L	M	S	--	--	M	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF ULTRASONICS

Introduction, Piezo Electric Devices, The Fields of ‘simple’, CW excited sources, The Pulsed Acoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays, Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation, Radiation Pressure.

TISSUE-ULTRASOUND INTERACTION

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theory of mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuation and Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissue organization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shear acoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation and tissue characterization.

SCANNING TECHNIQUES

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulse echo imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beam forming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converter-Analog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques-Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing. Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

REAL TIME ULTRASONICSCANNERS

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

ULTRASONIC APPLICATIONS

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

TEXT BOOKS:

1. Shirley Blackwell Cusick, Farman and Vicary, **“A User’s Guide to Diagnostic Ultrasound”**, Pitman Medical Publishing Co Ltd; Kent, England. (1978).
2. C.R.Hill, Jeff C.Bamber, Gail Haa, **“Physical Principles of medical Ultrasonics”**, John Wiley & Sons Ltd; 2^{nd} Edition, 2004.
3. W.N.McDicken, Churchill Livingstone, **“Diagnostic Ultrasonics – Principles and use instruments”**, New York, 3^{rd} Edition, 1991.

REFERENCES:

1. Timothy J.Hall, **“Physics Tutorial For Residents: Elasticity Imaging With Ultrasound, Radio Graphics”**, Vol.23, No.6, Nov-Dec 2003. (RSNA 2003).
2. Khandpur R.S, **“Hand Book of Biomedical Instrumentation”**, Tata McGraw Hill publication, New Delhi, 2^{nd} Edition 2003.
3. M.A.Flower, **“Webb’s Physics of Medical Imaging”**, 2nd Edition, CRC Press, Boca Raton, FL, 2012.
4. Thomas L.Szabo, **“Diagnostic ultrasound imaging Inside out”**, Elsevier Academic Press, London, 2004.

COURSE DESIGNERS

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17BMSE01	QUALITY MANAGEMENT IN HEALTHCARE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the Standardization & Quality Management in Hospitals.
2	To understand various Regulations and Accreditation for Hospitals.
3	To learn about the hospital safety management.
4	To Know about the electrical and fire safety management in hospitals.
5	To understand about the assessment of Quality healthcare.

COURSE OUTCOMES

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

CO1. Describe the total quality management in Healthcare.	Understand
CO2. Summarize FDA Regulations and accreditation for hospitals.	Understand
CO3. Examine the safety and security of Hospitals.	Apply
CO4. Analyze the Safety precautions in Electrical and fire accidents.	Analyze
CO5. .Assess the Quality healthcare in hospital.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--	--	M	S	M	L	--	--	M	-	M	M
CO2	S	--	--	--	--	M	--	S	L	--	--	M	S	M	S
CO3	S	L	M	--	--	S	--	S	M	--	--	M	S	M	S
CO4	S	L	M	M	--	S	S	S	M	--	M	M	M	M	S
CO5	S	L	S	M	--	S	--	S	S	--	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS
Define Quality- Need for Standardization & Quality Management**,** TQM in Health care organization – Quality assurance methods , QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments.

REGULATORY REQUIREMENT FOR HEALTH CARE
FDA regulations, Accreditation for hospitals **-** JCI, NABH and NABL, Other regulatory Codes.

HOSPITAL SAFETY
Security & Safety of Hospital – Property, Staff & Patients**,** Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste.

ELECTRICAL & FIRE SAFETY
Sources of shocks, macro & micro shocks – Hazards, monitoring and interrupting the Operation from leakage current – Elements of fire, causes of fire, Action to be taken in case of fire in a Hospital.

ASSESSING QUALITY HEALTH CARE
Patient Safety Organization- Governmental & Independent, Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction.

TEXT BOOKS

1. Cesar A. Cacere & Albert Zana, **"The Practice of Clinical Engineering"**, Academic press, Newyork, 1977.
2. Webster J.G and Albert M.Cook, **"Clinical Engineering, Principles & Practices"**, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.
3. B.M.Sakharkar, **"Principles of Hospital administration and Planning"**, JAYPEE Brothers, Medical Publishers (P) Ltd.

REFERENCES

1. K.Shridhara Bhat, **"Quality Management"**, Himalaya Publishing House.
2. Karen Parsley, Karen Parsley Philomena Corrigan, **"Quality improvement in Healthcare"**, 2nd Edition, Nelson Thrones Pub, 2002
3. Sharon Myers, **"Patient Safety & Hospital Accreditation - A Model for Ensuring Success"**, Springer Publishers 2012.
4. Joseph F Dyro, **"Clinical Engineering Handbook"**, Elsevier Publishers, 2004.

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17BMSE02	HOSPITAL ENGINEERING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To provide the knowledge of planning, designing and safety management in Hospital services. To introduce the students to the field of hospital and equipment management.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the overview of hospital organization and planning.
2	To study about the principles and tools of human resource management and manpower planning in hospitals.
3	To understand the process of recruitment and training in hospitals and to know about the various departments of hospital.
4	To plan the maintenance of records in the other supportive departments of hospital such as food, pharmacy.
5	To study about various types of communication and safety aspects in hospital.

COURSE OUTCOMES

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

CO1. Explain the various concept of Hospital administration.	Understand
CO2. Discuss the concept of HRM and method of Service.	Understand
CO3. Illustrate the supplementary services in hospitals.	Apply
CO4. Infer infection control, communication planning and safety aspect in hospital.	Analyze
CO5. Analyze the various services of Clinical and Administrative.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--	--	M	--	--	M	--	--	M	--	M	M
CO2	S	--	--	--	--	M	--	--	M	--	--	M	--	M	M
CO3	S	--	L	--	--	S	M	--	M	--	--	M	M	S	M
CO4	S	L	M	--	--	S	S	S	S	--	--	M	S	S	S
CO5	S	L	M	--	--	S	S	M	S	--	--	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF HOSPITAL ADMINISTRATION
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning – Roles of hospital in healthcare-hospital planning and design-outpatient services – Nursing unit – intensive care unit – nursing services.

CLINICAL AND ADMINISTRATIVE SERVICES
Radiology and imaging services-laboratory services – operation theatre suite pharmacy – Central sterile supply department- hospital infection- materials Management-evaluation of hospital services.

HUMAN RESOURCE MANAGEMENT, RECRUITMENT AND TRAINING
Principles of HRM – Functions of HRM – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

PLANNING SUPPORTIVE SERVICES
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services – Laundry Services.

COMMUNICATION, SAFETY ASPECTS IN HOSPITAL AND HOSPITAL INFECTION CONTROL
Purposes – Planning of Communication, Modes of Communication – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Importance of infection control-hand hygiene-aseptic techniques-isolation precautions-disinfection and sterilization.

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, NewDelhi – Fifth Reprint 2007.

REFERENCES

1. Cesar A. Caceres and Albert Zara, **"The Practice of Clinical Engineering"**, Academic Press, New York, 1977.
2. Sanjiv Singh, Sakthikumar Gupta, Sunil Kant, **"Hospital infection control Guidelines, principles and practice"**, Jaypee Brothers Medical Publishers Pvt.

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17BMSE03	TELEMEDICINE & PACs	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To enable the students to acquire knowledge about the principles of Telemedicine and Picture Archival Communication System.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn the fundamental concepts necessary to for any telemedicine and tele- health activity.
2	To know the importance of secure medical data transmission and retrieval.
3	To acquire an adequate knowledge about the system components in tele-radiology and telepathology.
4	To study in detail about the medical applications.
5	To study the need for digital imaging and picture archiving and communication systems (PACS).

COURSE OUTCOMES

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

CO1. Associate common medical applications for real time solutions.	Understand
CO2. Describe the fundamental concepts necessary for any telemedicine.	Understand
CO3. Examine the fault diagnosis system in telemedicine concepts.	Apply
CO4. Infer secure medical data transmission and retrieval.	Analyze
CO5. Categorize telemedicine applications and PACs.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	M	S	S	M	S	--	--	--	M	--	--	M
CO2	S	--	--	L	S	M	M	--	--	--	--	M	--	--	M
CO3	S	S	M	--	L	S	L	--	M	--	--	M	M	M	M
CO4	S	S	M	--	L	M	L	S	M	--	--	S	M	M	M
CO5	S	S	M	--	M	L	S	S	M	--	--	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

HISTORY OF TELEMEDICINE AND COMMUNICATION TECHNOLOGIES
Telemedicine: Definition and history, Block diagram, Scope, Benefits, Limitations, and Clinical applications – Real-time and store – forward, Types of information: Audio, Video, Still Images, Text and data, and Fax – Types of Communication and Network: PSTN, POTS, ATN, and ISDN – Basic concepts of Communication and Network: Internet, and Wireless communications (GSM, Satellite and Micro- wave), Types of antennas depending on requirements.

MEDICAL DATA SECURITY AND LEGAL ISSUES
Data Exchanges: Network configuration, Video conferencing – Data security and Standards: Encryption, Cryptography, Mechanisms and phases of encryption – Protocols and Standards – encryption, Ethical and legal aspects of Telemedicine, patient rights and consent form, access to medical records, Intellectual property rights.

TELE-RADIOLOGY & TELE-PATHOLOGY
Tele-radiology and its basic system components, Image acquisition system, Display system, Communication networks, Interpretation, Tele-pathology, Multimedia databases, color images of sufficient resolution, image compression methods, Interactive control of color and controlled sampling.

OTHER MEDICAL APPLICATIONS
Tele-dermatology, Tele-psychiatry, Tele-cardiology, Tele-trauma, role of tele-education, evaluation in telemedicine, Tele-oncology, Tele-surgery, security and confidentiality tools.

PICTURE ARCHIVAL COMMUNCIATION SYSTEMS (PACS)
Types of image formats, DICOM standard, PACS system: Block diagram, Storing & retrieving images, Algorithm for retrieving images, Compressions and its significance, Lossless data Storage and in-house communication, Computer aided diagnosis (CAD).

TEXT BOOKS

1. Olga Ferrer-Roca, M.Sosa Ludicissa, **"Handbook of Telemedicine"**, IOS press 2002.
2. Norris A.C, **"Essentials of Telemedicine and Telecare"**, John Wiley & Sons, 2002.
3. Wootton R, Craig J, Patterson, **"Introduction to Telemedicine"**, Royal Society of Medicine Press Ltd., 2nd Edition, 2006.

REFERENCES

1. Maheu M.M, Whitten P, Allen A, **"E-Health, Telehealth, and Telemedicine"**, Jossy-Bass, 2001.
2. Keith J, Dreyer, David S, Hirschron, James Thrall H, Amit Mehta, **"PACS: A Guide to the Digital Revolution"**, 2nd Edition, Springer.
3. Huang H K, **"PACS and imaging informatics – Basic Principles & application"**, Wiley-Blackwell.
4. Latifi R, **"Current Principles and Practices of Telemedicine and e-Health"**, Washington DC: IOHS, 2008.
5. Bashshur R L, Shannon G W, **"History of Telemedicine"**, New Rochelle. NY, Mary Ann Liebert Publishers, 2009.

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17BMSE04	HOSPITAL INFORMATION SYSTEM AND ITS MANAGEMENT	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of learning this course on hospital information system for biomedical engineering students is to acquire knowledge and understand the basic functionalities of hospital services.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn the basic role and designing of hospitals.
2	To understand the clinical and diagnostic services of hospitals.
3	Illustrate the basic supportive services and reporting systems in hospitals.
4	To study the need for staff and safety management.
5	To get the recent advances in healthcare system.

COURSE OUTCOMES

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

CO1. Discuss about the role of hospital planning.	Understand
CO2. Illustrate the various services in correct order to diagnose and treat the patients.	Apply
CO3. Utilize proper supportive services and material management to the hospital.	Apply
CO4. Outline the staff security and safety management in hospital.	Analyze
CO5. Evaluate the reporting system in various areas in hospital.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	--	--	--	--	--	--	L	--	--	S	M	S	M
CO2	S	S	M	--	--	L	M	M	M	--	--	S	M	S	M
CO3	S	S	M	--	--	L	M	M	M	--	--	S	M	S	M
CO4	S	M	S	--	--	M	S	S	S	M	--	S	S	M	S
CO5	S	M	S	L	--	S	M	S	S	S	--	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

ROLE OF HOSPITALS
Evolution of hospitals in India, roles of hospital in healthcare, Healthy hospital environment, Role of planning and designing in hospital management, Creating manpower services, Designing disabled friendly hospitals, Energy conservation.

CLINICAL AND DIAGNOSTIC SERVICES
Outpatient services, indoor services, Operation theatre services, Emergency services, Laboratory services, Radiology and imaging services, Nuclear medicine services, Experimental medicine services.

SUPPORTIVE SERVICES AND MATERIAL MANAGEMENT
Pharmacy services, Transport services, Engineering services, Medico legal services, Public relations, Food safety in hospitals, Materials management, Purchase and procurement system.

STAFF AND SAFETY MANAGEMENT
Human resource management, Nursing management, Biomedical waste management, Quality management, Occupational safety, Hospital security.

REPORTING SYSTEM AND RECENT ADVANCES IN HOSPITAL ADMINISTRATION
Medical record management, Office management, Operations research in hospitals, Emerging health insurance, Telemedicine clinic- mobile health, Information and communication technology in healthcare

TEXT BOOK:
1. Sonu Goel, Anil Kumar Gupta, Amarjeet Singh, **"Hospital administration A problem- solving approach"**, Elsevier, 1st Edition, 2014.

REFERENCES:

1. Sakharkar B M, **"Principles of hospital administration and planning"**, Jaypee Brothers Medical Publishers Pvt Limited, 2nd Edition, 2009
2. Kunders G D, **"Hospitals: Facilities planning and management"**, Tata Mcgraw Hill, 1st Edition, 2008.

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17BMSE05	HEALTH TECHNOLOGY MANAGEMENT AND ECONOMICS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

It is focused on exploring important and emerging topics on various perspectives of technology management and their impact on individuals, business, society and economic development in health care sector.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand of the economic, legal, ethical and regulatory environments of healthcare delivery.
2	To study the advancement in the clinical, industrial or consulting environments.
3	To learn the technical backgrounds with formal course work in business and management.
4	To provide a platform for the intersection of health management and economics.
5	To serve high-standard healthcare provision.

COURSE OUTCOMES

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

CO1. Explain the medical care services in government and private health organization.	Understand
CO2. Model the organizing function, structure and team network.	Apply
CO3. Outline frequency of preventive maintenance intervals and procedures for maintenance.	Analyze
CO4. Classify the basic concepts of management and economics.	Analyze
CO5. Design, development, commercialization, and regulatory compliance of medical devices, and the implementation hospital-based healthcare technologies.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	--	--	--	--	L	L	--	--	M	M	M	M
CO2	S	M	M	M	--	L	M	L	M	--	--	S	M	S	M
CO3	S	M	M	S	--	M	S	M	S	--	--	S	S	S	M
CO4	S	M	M	S	M	M	S	M	M	--	--	S	S	S	M
CO5	S	M	S	S	S	M	S	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Basic management concepts, functions and managerial process, managerial skills and competencies History, evolution and recent development in management theories: classical, neo-classical and modern .continuing management themes – quality management, learning organization. Application of management concepts to healthcare organizations.

PLANNING AND DECISION MAKING
Planning: meaning and nature of planning, types of plans, steps in planning process; Objectives: meaning, setting objectives – MBO method: concept and process of managing by objectives; Strategy: definition, levels of strategies; Policies: meaning, formulation of policies; Programs; Decision making, steps in decision making, approaches to decision making, types of decisions and various techniques used for decision making.

ORGANIZING
Organizing as managerial function – organization structures – functional, divisional, matrix, team structure, network structure, boundary less structure. Organizing – chain of command, span of control, delegation and decentralization, organizational design, hospital organizational structure and its nature. Leadership: meaning, styles and theories

HEALTH ECONOMICS
Health economics, nature & scope, role of economic analysis in health care decision making, basic concepts, resource allocation for public health and rationale of govt. intervention & control, objectives of health organization, health services demand and elasticity of demand, demand estimation & forecasting of health services. Determinants of costs of different medical services, opportunity cost, effectiveness accounting cost, marginal costing and their application in managerial decision making in health organization; criteria for investment decision in hospitals.

ECONOMIC DESIGN
Pricing strategies and tactics of medical care services in government and private health organization; Difference between profit and non-profit making health care institutions; Health in human development index. Frame work of economic, social and political environment in health care services, economic design & models, efficiency and economic evaluation, valuation of non-health services resources.

TEXT BOOKS:

1. Robbins, **"Fundamental of Management"**, Pearson Education.
2. Joan Gratto Liebler, Charles McConnell, **"Management Principles for Health Professionals"**, Jones & Bartlett Publishers, USA.
3. Rout, **"Health Economics in India"**, HS-New century publication, New Delhi.
4. Hederson, **"Health Economics & Policy",** Cengage, New Delhi.
5. D.N. Dwivedi, **"Managerial Economics"**, Himalya Publication, New Delhi.

REFERENCES:

1. Carney, Marie, **"Health Service Management"**, PHI Learning.
2. Kongstvedt, **"Essential of Management Health Care"**, Jones & Bartlett Publishers, USA.
3. Jones & Bartlett Publishers, **"Principle's of Health Care Management"**, USA.
4. Rana, **"Health Economics"**, HPS- Alfa publication, New Delhi.

COURSE DESIGNERS

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17BMSE06	PATIENT SAFETY & RISK MANAGEMENT IN HOSPITAL	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of this course on patient safety & risk management in hospital and radiation safety for patient is to acquire knowledge in concepts related to safe usage of radiation devices in medical field.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To Understand the concepts of radiation and its characteristics
2	To Describe mechanisms of different types of biological effects following exposure to radiation.
3	To Familiarize different types of radiation protection in nuclear medicine and oncology.
4	Explain radiation protection in diagnostic radiology.
5	To Understand the concepts of radiation hazards and protective measures in medical diagnosis.

COURSE OUTCOMES

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

CO1. Explain the concepts of radiation and its characteristics.	Understand
CO2. Examine the concepts of radiation protection in diagnostic radiology.	Apply
CO3. Analyze the different types of biological effects following exposure to radiation.	Analyze
CO4. Outline the problems and risk in common medical equipment in hospitals.	Analyze
CO5. Compare the various patient safety methods in hospitals.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	--	--	--	L	L	--	--	--	--	M	--	L	M
CO2	S	M	--	--	--	M	M	--	M	--	--	S	L	M	M
CO3	S	S	M	--	--	M	S	M	M	--	--	S	M	M	M
CO4	S	S	M	--	--	M	S	M	M	--	--	S	M	M	M
CO5	S	S	M	S	--	S	S	S	S	--	--	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

RADIATION BASICS

Atomic structure, characteristics of radiations, types of ionizing & non-ionizing radiations. Radioactive decay constant – half-life period, units of radiation and radioactivity Units of radiation risk, Relative Biological Effectiveness (RBE), Motion of electron in a crossed electric and magnetic fields, nuclear forces, nuclear model Radiation shielding principles, use of pocket dosimeters.

BIOLOGICAL EFFECTS
Acute biological effects of ionizing radiations, long term biological effects of ionizing radiations Typical radiation doses – background, medicine, and industry; dose limits for occupationally exposed individuals Techniques for limiting radiation doses to personnel Spontaneous mutation rate , effect of radiation on skin and blood forming organs, digestive tract – sterility and cataract formation Effects of chronic exposure to radiation.

RADIATION PROTECTION IN NUCLEAR MEDICINE AND ONCOLOGY
Nuclear medicine, diagnostic & therapeutic nuclear medicine Positron Emission Tomography (PET), special considerations for handling PET, intensity modulated radiation therapy Facility design, radiation protection of nuclear medicine staff Radiation oncology, external beam shielding, brachytherapy, low-dose-rate brachytherapy, Radiation hazards in brachytherapy departments and teletherapy departments and radioisotope laboratories – Particle accelerators.

RADIATION PROTECTION IN DIAGNOSTIC RADIOLOGY
Definition of free radicals and G-value, kinetics of radiation chemical transformations , LET and dose-rate effects, Safety assessment, facility design and shielding – BIR shielding method Teletherapy machines: reference conditions for measurement, Type of ion chambers, phantom, waterproof sleeve Unintended and accidental medical exposures, pregnancy procedures, Magnetic Resonance Imaging safety issues Derivation of an expression for machine timing error, procedure for evaluation of temperature and pressure correction.

RADIATION HAZARDS AND PROTECTIVE MEASURES
Planning of medical radiation installations – general considerations, design of diagnostic, deep therapy, telegamma and accelerator installations, brachytherapy facilities and medical radioisotope laboratories Evaluation of radiation hazards in medical diagnostic, therapeutic installations Radiation monitoring procedures – protective measures to reduce radiation , exposure to staff and patients, protective equipment – Handling of patients Radiation accidents in medicine , the role of recommendations and regulations Waste disposal facilities , radiation safety during source transfer operations, special safety features in accelerators, reactors.

TEXT BOOKS:

1. Mary Alice Statkiewicz Sherer, Paula J. Visconti, E. Russell Ritenour, Kelli Haynes, **"Radiation Protection in Medical Radiography"**, CRC Press, 7th Edition, 2008.
2. Richard J. Vetter,Magdalena S. Stoeva, **"Radiation protection in Medical imaging and Radiation oncology"**, CRC Press, Taylor and Francis group, 1st Edition, 2016.
3. Gopal B.Saha, **"Physics and Radiobiology of Nuclear Medicine"**, Springer, 3rd Edition, 2006.

REFERENCES:

1. Max H Lombardi, **"Radiation Safety in Nuclear Medicine"**, CRC Press, 2nd Edition, 2007.
2. Daniel Farb, Bruce Gordan, **"Occupational Radiation Safety Guidebook"**, University of Health Care, 2005.
3. Robert J. Emery and Janelle Rios, **"Operational Radiation Safety"**, Vol. 110, No. 2, February 2016.
4. B.H Brown , PV Law ford, R H Small wood , D R Hose , D C Barber , **"Medical Physics and Biomedical Engineering"**, CRC Press, 1999 .
5. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Standards, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1578_web-57265295.pdf.

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17BMSE07	MEDICAL RADIATION SAFETY ENGINEERING	Category	L	T	P	Credit
		PS-SE	3	0	0	3

PREAMBLE
To impart sufficient information on the various precautionary and safety measures for radiation protection in medicine.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To provide an insight to the basics of radiation physics.
2	To enable them understand the guidelines of radiation protection and radiation detectors.
3	To provide information on safety measures related to UV, laser and nuclear medicine.

COURSE OUTCOMES

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

CO1. Explain the Radio frequency and Microwave radiations.	Understand
CO2. Examine the Laser and UV radiation control measure.	Apply
CO3. Outline the protective measures and radiation hazards in nuclear medicine and radiotherapy.	Analyze
CO4. Assess the various monitoring methods & Hazard in radiation protection	Evaluate
CO5. Designing to reduce the radiation hazards.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	L	--	--	--	M	M	M	--
CO2	S	M	M	--	--	M	M	M	L	--	--	M	M	S	M
CO3	S	S	M	M	--	M	S	M	M	--	--	M	M	S	M
CO4	S	S	S	S	--	S	S	S	S	--	M	S	M	S	S
CO5	S	S	S	S	M	S	S	S	S	--	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO RF AND MICROWAVE RADIATION
Sources of radio frequency radiation – Effects of radio frequency radiation – Development of standards for human safety – Calculation of RF field quantities – RF radiation measuring instruments and methods.

RADIATION DETECTION AND MEASUREMENT
Fundamentals of radiation detection – Conducting radiation measurements and surveys – Gas detectors – Designing to reduce radiation hazards – Radio frequency radiation safety management and training – Scintillation detectors – Statistics of Counting – minimum detectable activity – Quality assurance of radiation counters.

RADIATION SAFETY IN NUCLEAR MEDICINE AND RADIOTHERAPY
Design and description of NM department – Radiation protection in nuclear industry – Guidelines for radiation protection- Molecular medicine and radiation safety program procedures for safe operation of radiation equipment – Radiation protection in external beam radiotherapy – Radiation protection in brachytherapy – Radioactive wastes.

LASER AND ULTRAVIOLET RADIATION SAFETY
Classification of UV radiation – Sources of UV – Biological effects of UV – Hazards associated with UV radiation – UV control measures – Safety management of UV Classifications of LASER and its radiation hazards – control measures – Emergencies and incident procedures.

MONITORING AND INTERNAL DOSIMETRY
Monitoring methods – personal radiation monitoring – Records of personal dosimetry – ICRP method – MIRD method – Internal doses from radiopharmaceuticals – Bioassay of radioactivity –Hazard and risk in radiation protection – radiological incidents and emergencies – Regulation to radiation protection.

TEXT BOOKS:

1. Jamie V Trapp, Thomas Kron, **"An introduction to radiation protection in medicine"**, CRC press Taylor & Francis group, 2008
2. Alan Martin, Samuel Harbison, Karen Beach, Peter Cole, Hodder Arnold, **"An introduction to radiation protection"**, 6th Edition 2012.

REFERENCES:

1. Max Hlombardi, **"Radiation safety in nuclear medicine"**, CRC Press Taylor & Francis group, 2nd Edition, 2007.
2. Aruna Kaushik, Anupam mondal, B.S. Dwarakanath, R.P.Tripathi, **"Radiation protection manual"**, INMAS, DRDO, 2010.
3. Ronald kitchen, **"RF and microwave radiation safety"**, Newness publishers, 2nd Edition, 2001.

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17BMSE08	MEDICAL INFORMATICS	Category	L	T	P	Credit
		PS-SE	3	0	0	3

PREAMBLE
To study the applications of information science and its impact in medical field.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the hospital management system and integrated hospital information system.
2	To know about the basic concepts of artificial intelligence and expert systems.
3	To study the hospital management information systems and computer assisted patient education.
4	To understand the concept of 3 dimensional imaging and its applications.
5	To study the concepts of telemedicine, its issues and reliability.

COURSE OUTCOMES

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

CO1. Explain the function of Hospital Information Systems.	Understand
CO2. Discuss the various concept of Hospital management and information system.	Understand
CO3. Model the 3-dimensional imaging and its applications.	Apply
CO4. Analyze medical standards.	Analyze
CO5. Infer the concepts of artificial intelligence and expert systems.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	--	M	M
CO2	M	--	--	--	--	--	--	--	--	--	--	M	--	M	M
CO3	S	M	M	M	M	L	M	--	M	--	--	M	--	M	M
CO4	S	M	--	S	--	M	S	--	M	--	--	S	M	S	M
CO5	S	M	--	S	--	M	S	--	M	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Structure of Medical Informatics, Internet and Medicine, Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics, Medical Informatics, Bioinformatics.

COMPUTERIZED PATIENT RECORD
History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology, Application server provider, Clinical information system, Computerized prescriptions for patients.

COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGINING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System, Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance

COMPUTER ASSISTED MEDICAL DECISION-MAKING
Neuro-computers and Artificial Neural Networks application, Expert system, General model of CMD, Computer-assisted decision support system, production rule, system cognitive model, semester networks, decisions analysis in clinical medicine, computers in the care of critically patients, computer assisted surgery, designing.

RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine, Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics, Computer assisted patient education and health, Medical education and health care information.

TEXT BOOKS:

1. R.D.Lele **“Computers in medicine progress in medical informatics”**, Tata Mcgraw Hill Publishing Ltd, 2005, New Delhi.
2. Mohan Bansal, **“Medical informatics”**, Tata Mcgraw Hill Publishing computers Ltd, 2003, New Delhi.

REFERENCES:

1. Hsinnchun Chen, **“Medical Informatics: Knowledge Management and Data Mining in Biomedicine”**, Springer, 2005.
2. F. T. De Dombal, **“Medical Informatics: The Essentials”**, Butterworth-Heinemann, 1996.
3. Charles P. Friedman, Jeremy C. (EDT) Wyatt, **“Evaluation Methods in Medical Informatics”**, Springer Verlag, 1997.

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17BMSE09	HOSPITAL MANAGEMENT DESIGN LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To understand all aspects of planning and commissioning of different types of hospital including specialty hospitals and project management.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To build a consumer-focused integrated primary health care system;
2	To improve access and reduce inequity;
3	To increase the focus on health promotion and prevention, screening and early intervention.
4	To improve quality, safety, performance and accountability.

COURSE OUTCOMES

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

CO1. Use their overall health care industry knowledge to identify select health care management career paths, work effectively in middle management positions within health care organizations, and use as a springboard for advancing both future educational and career objectives	Apply
CO2. Use leadership and management skills to create a productive working environment within different types of health care organizations that supports the organization's vision, mission, values, and activities	Apply
CO3. Analyze the quality, safety, performance and accountability.	Analyze
CO4. Assess individual and organizational professionalism in their approach to their career, their organization, and their relationships within the health care industry.	Evaluate
CO5. Create model for hospital building, architectural patterns, landscaping Internal arrangements, sanitation, lighting, ventilation	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	M	M	L	M	--	--	S	M	M	S
CO2	S	M	M	M	--	M	M	L	M	--	--	S	M	S	S
CO3	S	S	M	S	M	M	S	M	S	--	M	S	M	S	S
CO4	S	S	S	S	S	M	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S

S-Strong; M-Medium; L-Low

SYLLABUS

1. Changing health care concept in planning / designing.
2. Site surveys for planning a hospital (Techno-Commercial)
3. Hospital building, architectural patterns, landscaping
4. Internal arrangements, sanitation, lighting, ventilation and traffic control
5. Planning of 30,100,250 bedded hospital(general/specialty)
6. Planning of 500, 750 and above bedded hospital(teaching/super-specialty/non-teaching specialty hospitals)
7. Project cost and total budget : Feasibility and viability study of Hospital
8. Project conceptualization, functional requirements. Implementation.

REFERENCES:

1. **"Hospital and Health Services Administration: Principles and Practices"** by Syed Amin Tabish. First Edition, Oxford University press New Delhi 2002,
2. **"Principles of hospital administration"**, McGibony, John Robert,New York, Putnam, [1952]
3. **"NIHFW Monographs"** – Govt. of India, New Delhi

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17BMSE10	DATA ACQUISITION AND PROCESSING LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE

The purpose of the course on data acquisition and processing is able to understand the concepts of hardware and software data acquisition system and create virtual instruments using Lab VIEW to measure physical and biological quantities.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study the basic data acquisition of hardware and software configuration.
2	To study the various digital filters and its implementation.
3	To study in detail about data acquisition system used in medical device.
4	To use data acquisition systems to measure physical quantities.
5	To create virtual instruments using Lab VIEW.

COURSE OUTCOMES

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

CO1. Utilize data acquisition software and hardware to collect data from biological system.	Apply
CO2. Analyze the graphical program for instrumentation.	Analyze
CO3. Measure the various physiological signals by sensors and transducers.	Evaluate
CO4. Develop computerized instrumentation systems for hospital processes using interface electronics, data acquisition card, serial instruments.	Create
CO5. Design and implement some experiments concerning temperature measurement using thermocouple.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	P4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	M	L	L	L	M	--	L	S	M	S	M
CO2	S	S	S	S	M	M	M	--	S	--	L	S	S	S	S
CO3	S	S	S	S	M	M	M	M	S	M	M	S	S	S	M
CO4	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

1. Data Acquisition Hardware and Software configuration
2. Software Development Method and interface implementation
3. Instrumentation system and Instrument Control
4. Graphical programming for instrumentation
5. Signal Conditioning and signal processing
6. Digital Signals and processing
7. Digital Filters Design
8. Digital Filters Implementation

REFERENCES:

1. Johnson Gary, **"LabVIEW graphical programming"**.
2. **"LabVIEW Basic Programming manual and LabVIEW data acquisition manual"**, National instrument.

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17BMSE11	THERAPEUTIC EQUIPMENTS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To make the students aware of various therapeutic equipment's in use and to ensure the students to use the therapeutic equipment in a safe and effective manner.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To acquire an adequate knowledge about the need of cardiac pacemakers and defibrillators.
2	The fundamental principle and working of the biomedical surgical instruments.
3	It deals with artificial kidney.
4	It provides the knowledge about Anesthesia machine and X-ray machine.
5	Enable the students to understand the Artificial respiration.

COURSE OUTCOMES

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

CO1. Describe the working of therapeutic equipments.	Understand
CO2. Use the various types of equipments for therapeutic applications.	Apply
CO3. Infer the relationship and interaction between the equipments and physiological system.	Analyze
CO4. Categorize the instruments for cardiology, physiotherapy, electrotherapy, ventilator, Anesthesia & radiotherapy.	Analyze
CO5. Measure the parameters of various therapeutic equipments.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	L	--	--	--	--	--	S	--	M	M
CO2	S	L	--	--	--	M	M	--	--	--	--	S	M	S	M
CO3	S	M	M	L	--	M	S	M	M	--	--	S	S	S	S
CO4	S	M	M	L	--	M	S	M	M	--	--	S	S	S	S
CO5	S	M	M	M	--	S	S	S	M	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INSTRUMENTS FOR CARDIOLOGY

Cardiac Pacemakers – Need for Cardiac Pacemaker – External Pacemakers – implantable Pacemakers – Recent Developments in Pacemaker system analyzer. Cardiac Defibrillators – Need for a Defibrillator – DC Defibrillator – Implantable Defibrillators – Pacer-cardio vector – defibrillator analysis.

PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS

High frequency heat therapy, shortwave diathermy, microwave diathermy, ultrasonic therapy unit, surgical diathermy, electro diagnostic/therapeutic apparatus pain relief through electrical stimulation.

VENTILATORS

Mechanics of Respiration artificial ventilation, ventilators, types of ventilators, ventilator terms, and classification of ventilators, pressure-volume-flow diagrams, modern ventilators, high frequency ventilators, humidifiers, nebulizers and aspirators.

LITHOTRIPTORS AND ANAESTHESIA MACHINE

The Stone Disease Problem, First Lithotripter Machine, Modern Lithotripter Systems, Extra-corporeal Shock-wave Therapy, Need for Anaesthesia, Anaesthesia Machine, Electronics in the Anaesthetic Machine.

RADIOTHERAPY EQUIPMENT'S AND AUTOMATED DRUG DELIVERY SYSTEMS

Use of high voltage X-ray machine, development of Beatron, Cobalt-60 machine, Medical linear accelerator machine, Infusion pumps, components of Drug – Infusion pumbs, Implantable Infusion Systems, Closed loop Control in Infusion Systems, Examples of Typical Infusion Pumps.

TEXT BOOK

1. R. S. Khandpur, **"Handbook of biomedical Instrumentation"**, Tata McGraw Hill Publication company Ltd, New Delhi, 1997.

REFERENCES

1. Joseph J. Carr, John Michael Brown, **"Introduction to Biomedical Equipment Technology"**, 4^{th} Edition, Pearson Education, 2001.
2. John G. Webster, **"Biomedical Instrumentation"**, Wiley Publications, 2007.

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17BMSE12	ASSIST DEVICES	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

A medical assistive device is any tool or equipment that helps a person to carry out normal activities of daily living. Some types of assistive technology provide physical and physiological assistance, while others provide helpful aids for individuals with learning disabilities. Through this course, the students will be able to understand, learn and use different engineering disciplines and apply these concepts in medical and biological stream.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To understand the basic concept of assist devices.
2	To use appropriate device for improving the function of human body parts.
3	To categorize the various human assist devices.
4	To outline working principle and monitoring the various parameter of assist devices.
5	To illustrate the human and assist device interaction.

COURSE OUTCOMES

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

CO1. Explain the functional components of human assist devices.	Understand
CO2. Apply the basic principle for the correct usage of device to solve the human disabilities.	Apply
CO3. Classify the different types of components, instruments and methods used to assist the human beings.	Analyze
CO4. Analyze the instrumentation and their parameters for optimal functioning of assist devices.	Analyze
CO5. Analyze the relationship and interaction between the devices and human body.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	--	--	--
CO2	S	M	--	--	L	--	--	--	M	--	--	M	M	M	S
CO3	S	M	M	--	M	M	--	--	S	--	--	S	S	M	S
CO4	S	M	S	--	M	M	--	--	S	--	--	S	S	M	S
CO5	S	M	S	--	M	M	--	--	S	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

CARDIAC ASSIST DEVICES

Principle of External counter pulsation techniques, Intra-Aortic Balloon Pump, Ventricular Assist Devices, Total artificial hearts, Heart-Lung machine, Prosthetic heart valves, Pacemaker, Defibrillator.

ARTIFICIAL KIDNEY

Functions of the kidney, Renal Disease, Principle of dilalysis, Membranes for Haemodialysis, Dialysis Water and Dialysate, Dialyzers, Performance Analysis of Dialyzers, Access for Haemodialysis, Haemodialysis machine – Blood circuit, Dialysis. fluid circuit, Dialyzer Reuse, Portable kidney machine.

PROSTHETIC AND ORTHODIC DEVICES
Materials in Rehabilitation Aids, Limb Prosthesis – Lower limb and Upper limb prosthesis, Functional Prosthesis – Body powered, and Myoelectric prosthesis. Spinal orthosis, Functional Electrical Stimulation, Haptic Devices, Assistive technology for blind and visually impaired, Visual Prostheses, Cochlear Prostheses.

AUDIOMETERS AND HEARING AIDS
Mechanism of Hearing, Measurement of sound, Basic audiometer, Pure tone audiometer, Speech audiometer, Audiometer system Bekesy, Evoked response audiometry system, Calibration of audiometers, Acoustic immittance measuring device, Hearing aids.

VENTILATORS
Mechanics of Respiration, Artificial ventilation, Ventilators components, Ventilator terms, Classification of ventilators, Pressure-volume-flow diagrams, Modern ventilators, High frequency ventilators, Humidifiers, Nebulizers and aspirators, Anaesthesia machine.

TEXT BOOKS:
1. Khandpur R.S., **"Handbook of Biomedical Instrumentation"**, Second Edition, Tata McGraw Hill Publication Company Ltd., 2003.
2. John T. Daugirdas, Peter Gerard Blake, Todd S. Ing, **"Handbook of Dialysis"**, Fifth Edition, Wolters Kluwer Health, 2015.

REFERENCES:
1. AK Agarwal, **"Essentials of Prosthetics and Orthotics"**, First Edition, Jaypee Brothers Medical Publishers (P) Ltd, 2013.
2. John G. Webster, **"Encyclopedia of medical devices and instrumentation"**, Second edition, John Wiley & Sons, 2006.

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17BMSE13	BIOMECHANICS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Biomechanics is the study of how the systems and structures of biological organisms, from the smallest plants to the largest animals, react to various forces and external stimuli. In humans, biomechanics often refers to the study of how the skeletal and musculature systems work under different conditions.Scientists often try to apply physics and other mathematically based forms of analysis to discover the limits and capabilities of biological systems.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Explain the principles of mechanics.
2	To study the fluid biomechanics of physiological systems.
3	Discuss the solidbiomechanics of physiological systems.
4	Explain the mechanics of joints.
5	Illustrate the mathematical models used in the analysis of biomechanical systems.

COURSE OUTCOMES

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

CO1. Discuss the principles of biomechanics.	Understand
CO2. Explain the fundamentals of biosolid mechanics in physiological systems	Understand
CO3. Apply the knowledge of joint mechanics.	Apply
CO4. Outline the bio fluid dynamics in biomechanical systems.	Analyze
CO5. Design computational mathematical modelling applied in biomechanics.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	--	M	M
CO2	M	--	--	--	--	--	--	--	--	--	--	M	--	M	M
CO3	S	M	--	--	--	--	--	--	--	--	--	S	M	M	S
CO4	S	S	--	M	--	L	--	L	M	--	--	S	M	S	S
CO5	S	S	S	S	M	M	--	M	M	--	M	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MECHANICS

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 Non-viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

INTRODUCTION TO BIOFLUID MECHANICS
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 characterization, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

BIOSOLID MECHANICS
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.

BIOMECHANICS OF JOINTS
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.

MODELING AND ERGONOMICS
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.

TEXT BOOKS:

1. Y.C. Fung, **"Bio-Mechanics-Mechanical Properties of Tissues"**, Springer-Verlag, 1998.
2. Subrata Pal, **"Text book 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. Mansfeild, **"Human Response to Vibration"**, CRC Press, 2005.
6. Carl J. Payton, **"Biomechanical Evaluation of movement in sports and Exercise"**, 2008.

COURSE DESIGNERS

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17BMSE14	NEURAL ENGINEERING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To acquire knowledge in neurological diseases and various electroencephalography clinical applications like monitoring epilepsy, porphyric neuropathy and the study of sleep disorders in humans.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To discuss the physiological concepts of nerve impulse generation and Electromyography.
2	To study about EEG and its various applications.
3	To understand the evoked potentials and its importance in medicine.
4	To introduce various techniques to study central and peripheral nerve function.
5	To discuss the electrophysiological evaluation in special situations.

COURSE OUTCOMES

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

CO1. Explain the physiology behind generation of nerve impulses.	Understand
CO2. Use various techniques to examine the functioning of central and peripheral nervous system.	Apply
CO3. Diagnose various disorders using electroencephalography.	Analyze
CO4. Compare the normal and abnormal signal from a healthy and a diseased nervous system.	Evaluate
CO5. Measure evoked potential and brain waveform using related techniques.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	L	--	--	--	--	--	M	--	S	S
CO2	S	M	L	--	--	M	--	L	M	--	--	M	--	S	S
CO3	S	M	L	--	--	M	--	M	M	--	--	M	--	S	S
CO4	S	S	L	--	--	M	--	S	M	--	--	S	M	S	S
CO5	S	S	M	L	--	M	--	S	M	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

NERVE EXCITABILITY AND ELECTROMYOGRAPHY

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications, clinical

Electromyography (EMG), Quantitative EMG, Neuromuscular Ultrasound as a compliment to the electrodiagnostic evaluation, Electrophysiologic study of Disorders of Neuromuscular Junction:, H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

ELECTROENCEPHALOGRAPHY
Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artefacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, Magnetoencephalography.

EVOKED POTENTIALS
Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.

FUNCTIONAL NEUROIMAGING AND COGNITION
Historical and physiological perspective, Functional neuroimaging methods: PET and fMRI, Network analyses, Functional neuroimaging of: Attention, Visual recognition, Semantic memory, Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS
Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of: brain death, patients in the intensive care unit, patients with suspected neurotoxic disorders.

TEXT BOOKS:
1. Michael J. Aminoff, et. al., **"Aminoff's electrodiagnosis in Clinical Neurology"**, Sixth Edition, Elsevier Saunders, 2012.
2. Kim E. Baretteet. al., **"Ganong's review of Medical Physiology"**, 23rd Edition, McGraw Hill Medical, 2010.

REFERENCES:
1. Eric R. Kandelet. al., **"Principles of Neural Science"**, McGraw-Hill, New York, 2012
2. R. Cooper, et. al, **"Techniques in Clinical Neurophysiology: A Practical Manual"** , Elsevier, Amsterdam, The Netherlands, 2005.
3. Holodny, Andrei I., et al, **"Functional neuroimaging: a clinical approach"**, Informa Health Care, 2008.

COURSE DESIGNERS

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17BMSE15	BIOMATERIALS AND ARTIFICIAL ORGANS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

A biomaterial is any substance that has been engineered to interact with biological systems for a medical purpose. These materials are synthesized in the laboratory using a variety of chemical approaches utilizing metallic components, polymers, ceramics or composite materials. It can be used every day in orthopedic application, dental applications, and surgery. The primary objective of this course is to impart the knowledge on biomaterials needed to solve challenges in the biomedical engineering.

PRERQUISITE : NIL

COURSE OBJECTIVES

1	To understand the properties of material for medical use.
2	To illustrate the applications of materials used in soft and hard tissue replacements.
3	To categorize classes of materials suitable for implant applications.
4	To outline the host response to the biomaterial and degradation of implant materials.
5	To the testing of material and analyze the various artificial organs.

COURSE OUTCOMES

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

CO1. Describe the characterization of material and different classes of biomaterials.	Understand
CO2. Illustrate the various soft tissue replacement and orthopedic implants in hard tissue replacements.	Apply
CO3. Illustrate the types, properties, manufacturing methods and applications of various biomaterials.	Analyze
CO4. Analyze the mechanism of host-tissue interaction and failure of materials.	Analyze
CO5. Analyze the protocol to test the biomaterials and the design criteria of artificial organs.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	--	--	--	--	--	--	--	M	--	--	M	--	M	M
CO2	M	M	M	--	-	--	--	--	S	--	--	S	--	M	M
CO3	S	S	--	--	--	L	--	--	S	--	--	S	S	S	M
CO4	S	S	--	--	--	M	--	--	S	--	--	S	S	S	S
CO5	S	S	M	--	--	M	--	--	S	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOMATERIALS: Biomaterials – Definition, Classification of biomaterials, Structure of solids, Material characterization – Mechanical, thermal, Phase diagrams, Surface properties, Electrical, Optical, X-ray absorption, Acoustic and Ultrasonic, Density and porosity, Diffusion properties. Engineered natural materials, Technologies of biomaterials processing, Surface Coatings Methods, Surface modification of materials.

CLASSES OF BIOMATERIALS: Metals: Stainless steel, Cobalt-Chromium alloy, Titanium alloys. Polymers: Classification and Synthesis, Polyesters, Polyamides, Polyacrylates, Silicones, Hydrogels, Fluorocarbon polymers. Ceramics: Alumina, Zirconia, Hydroxyapatites. Composites as biomaterials.

SOFT AND HARD TISSUE APPLICATIONS: Sutures, Adhesives, Wound dressings, Maxillofacial and other Soft-tissue augmentation, Heart valve implant, Cardiovascular Grafts and Stents, Orthopedic fixation devices: Internal fixation devices- Wires, Pins, Screws, Fracture Plates and Intramedullary Devices. Joint replacement - Hip joint replacements, Knee joint replacements, Ankle joint replacement, Upper Extremity joint replacements, Dental implants.

HOST RESPONSE AND MATERIAL FAILURE: Host Reaction to Biomaterials - Inflammation, Wound healing, Foreign-body reaction, Blood–Materials Interactions. Degradation of Implanted Materials - Deterioration of polymers, Biodegradation of biostable and biodegradable polymers, Metal corrosion, Ceramic degradation. Device failure mode analysis.

BIOMATERIAL TESTING AND ARTIFICIAL ORGANS: Testing of biomaterials: In-vitro, In-vivo preclinical tests, Sterilization of implants and devices, Artificial Blood, Artificial skin, Artificial Heart, Artificial Kidney, Artificial lung (oxygenator), Artificial Pancreas, Eye and Ear implants.

TEXT BOOKS:

1. Joon park, R.S. Lakes, **"Biomaterials and introduction"**, 3rd Edition, Springer Science Business Media LLC, 2007.
2. BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, **"An introduction to Materials in Medicine"**, 3rd Edition, Academic Press, 2013.

REFERENCES:

1. Sujata V. Bhatt, **"Biomaterials"**, Second Edition, Narosa Publishing House, 2005.
2. Joseph D. Bronzino, **"The Biomedical Engineering Hand Book"**, Second Edition, CRC Press LLC, 2000.

COURSE DESIGNERS

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1	Mr.K.Natarajan	Associate Professor	BME	natarajank@vmkvec.edu.in
2	Ms.B.Farhana Ansoor	Assistant Professor (G-I)	BME	farhanaansoor@avit.ac.in

17BMSE16	WEARABLE TECHNOLOGY	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE
This course makes the students to understand the fundamentals and applications of the wearable technology.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the fundamentals of sensors and wearable technology.
2	To ascertain the design and integration of the smart textiles.
3	To understand the electronic textiles.
4	T endeavor various sensor in sports wearable application.
5	To understand the cloud storage of wearable devices.

COURSE OUTCOMES

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

CO1. Discuss the fundamentals of sensor and wearable technology.	Understand
CO2. Illustrate the electronic textiles and its applications.	Apply
CO3. Analyze the sensor for different wearable applications.	Analyze
CO4. Compare the various data storage of wearable systems.	Evaluate
CO5. Design of smart clothing.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	--	L	--	--	S	M	M	S
CO2	S	M	L	L	--	--	--	--	M	--	--	S	S	M	S
CO3	S	M	M	M	S	M	L	--	M	--	--	S	S	S	S
CO4	S	S	S	S	S	S	M	M	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	M	M	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF SENSORS AND WEARABLE TECHNOLOGY
Introduction to sensors – Sensor Physical Properties – Electric (Resistive, Capacitive and Inductive) – Piezoelectric – Optic – Photo elastic - Thermoelectric – Electrochemical.
Wearable computers – Wearable Electronics – Intelligent Clothing – Industry on wearable technology – Current Trends – Market Forecast.

SMART CLOTHING
Introduction – Design of Smart Cloths – 2D Design for smart wearables – Textile Development – 3D Design for smart wearables – Construction of smart wearables – Integration – Prototype Development.

ELECTRONIC TEXTILES
Conductive Fibers for textiles – Conductive for Polymers textiles – Carbon Nanotubes yarns – Textile and Electronics Integration - Embroidered Antenna – Electronic textiles for Military Applications.

SENSOR FOR WEARABLE APPLICATIONS
Load and Pressure Measurement sensor – Sports Applications – Inertial Sensor – Sports Application – Optical Sensor – Sports Application – Angle & Displacement Sensor – Sports Application.

DATA STORAGE FOR WEARABLE TECHNOLOGY
Introduction – Storage in Consumer wearable - Cloud storage – Remote Cloud – Sensor Cloud – Cloudlet - Cloud storage Architecture – Confidential disk and Cloud storage with encryption – Two-layer confidential storage.

TEXT BOOKS:
1. Patrick F. Dunn, **"Fundamentals of Sensors for Engineering and Science"**, CRC Press, Taylor & Francis.
2. Jane McCann, David Bryson, **"Smart Clothes and Wearable Technology"**, CRC Press, Woodhead Publishing Ltd.

REFERENCES:
1. Daniel A. James, Nicola Petrone, **"Sensors and Wearable Technologies in Sport: Technologies, Trends and Approaches for Implementation"**.
2. Marrington, Andrew, Kerr, Don, **"Management Association, Information Resources Managing Security Issues and the Hidden Dangers of Wearable Technologies"**.
3. Tilak Dias, **"Electronic Textiles: Smart Fabrics and Wearable Technology"**, Elsevier, Woodhead Publishing.

COURSE DESIGNERS

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17BMSE17	BRAIN COMPUTER INTERFACE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Brain-computer interface (BCI) is a collaboration between a brain and a device that enables signals from the brain to direct some external activity, such as control of a cursor or a prosthetic limb. The interface enables a direct communications pathway between the brain and the object to be controlled.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn the basics of brain computer interfacing and to study about data acquisition, hardware and software requirements.
2	To study about the BCI approaches.
3	To get an idea about EEG Feature Extraction methods.
4	To acquire knowledge about EEG Translation methods.
5	To acquire knowledge about MATLAB tools for BCI.

COURSE OUTCOMES Describe about the BCI approaches.

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

CO1. Describe about the brain computer interface approaches.	Understand
CO2. Examine the development of brain computer interfacing.	Apply
CO3. Outline the knowledge about EEG Translation methods.	Analyze
CO4. Evaluate the data acquisition, hardware and software requirements.	Evaluate
CO5. Develop MATLAB based tools for brain computer interface.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	L	--	--	--	--	--	--	M	--	M	M
CO2	S	M	M	--	M	L	--	--	L	--	--	S	--	M	M
CO3	S	S	S	--	M	M	--	--	M	--	L	S	S	S	S
CO4	S	S	S	S	S	S	M	S	S	M	M	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to Brain computer interfaces, The Evolution of BCIs, Brain signals for BCIs: Neuronal Activity in motor cortex and related areas, Electrical and Magnetic fields produced by the brain, Signals reflecting brain metabolic activity, Concept of BCI, Invasive and Non-invasive Types, EEG Standards, Signal Features, Spectral Components, EEG Data

Acquisition, Pre-processing, Hardware and Software, Artifacts, Methods to Remove, Near Infrared BCI.

BCI APPROACH METHODS
Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

EEG FEATURE EXTRACTION METHODS
Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering PCA – Laplacian Filters – Linear and Non-linear Features.

EEG FEATURE TRANSLATION METHODS
LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

MATLAB-BASED TOOLS FOR BCI
Introduction, Data Streaming: Field Trip, Data-Suite: Data-River and Mat-River, EEGLAB Online Data Processing: A minimalistic BCI script using native MATLAB code, Other MATLAB BCI Classification tools, BCILAB.

TEXT BOOKS:

1. Jonathan R. Wolpaw, Elizabeth Winter Wolpaw, **“Brain computer interfaces principles and practice”**, Oxford University Press - 2012.
2. Desney S, Tan & Anton Nijholt, **“Brain Computer interfaces: Applying our minds to human computer interaction”**, Springer Science and Business Media, 2010.

REFERENCES:

1. Bernhard Graimann, Brendan Allison, Gert P furtscheller, **“Brain computer interfaces Revolutionizing Human – Computer interaction”**, Springer-2010.
2. Special Issue on **“Brain Control Interfaces”**, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
3. Andrew Webb, **“Statistical Pattern Recognition”**, Wiley International, Second Edition, 2002.
4. R.Spehlmann, “**EEG Primer”**, Elsevier Biomedical Press, 1981.

COURSE DESIGNERS

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17BMSE18	ROBOTICS & AUTOMATION IN MEDICINE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of learning this course on automation and robotics in medicine to acquire knowledge and understand the basic function and to create new application of robotic and automation system in medical field especially in surgery.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the basics of Robotics, Kinematics.
2	To understand the basics of Inverse Kinematics.
3	To explore various kinematic motion planning solutions for various Robotic configurations.
4	To study the basic inverse Kinematic motion planning solutions.
5	To explore various applications of Robots in Medicine.

COURSE OUTCOMES

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

CO1. Understand the basics of robotic systems.	Understand
CO2. Illustrate the application of automation and robotics in medicine.	Apply
CO3. Categorize the level of planning for various Robotic configurations.	Analyze
CO4. Compare Robotics system and formulate Kinematics.	Evaluate
CO5. Design Robotic systems for Medical application.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	L	L	--	--	--	--	L	--	--	M	--	M	S
CO2	S	--	M	M	--	--	--	M	M	--	--	S	M	S	S
CO3	S	S	S	M	M	--	L	M	M	--	L	S	M	S	S
CO4	S	S	S	S	S	S	M	S	S	M	M	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S	M	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot.

KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering, Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery.

TEXT BOOKS:

1. Robert Schilling, "**Fundamentals of Robotics-Analysis and control"**, Prentice Hall, 2003.
2. J.J.Craig, **"Introduction to Robotics"**, Pearson Education, 2005.

REFERENCES:

1. Staugaard, Andrew C, **"Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning"**, Prentice Hall Of India, 1987
2. Grover, Wiess, Nagel, Oderey, **"Industrial Robotics: Technology, Programming and Applications"**, McGraw Hill, 1986.
3. Wolfram Stadler, **"Analytical Robotics and Mechatronics"**, McGraw Hill, 1995.
4. Saeed B. Niku, **"Introduction to Robotics: Analysis, Systems, Applications"**, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, **"Robotics"**, McGraw Hill, 2008.

COURSE DESIGNERS

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17BMSE19	ASSIST DEVICES LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE

The curriculum of Assist devices lab is concerned to enable the students to know and operate the various Assist devices.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Application of Pacemaker and defibrillator.
2	Recording and diagnosis EEG.
3	Function of Hemodialysis.
4	Working of Heart lung machine.
5	Usage of Audiometer.

COURSE OUTCOMES

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

CO1. Discuss the working principle of ventilators, Drug delivery system and anesthesia machine.	Understand
CO2. Demonstrate pacemaker and defibrillator.	Apply
CO3. Demonstrate Haemodialysis and Heart Lung machine	Apply
CO4. Record and analyze PC based EEG signals.	Analyze
CO5. Diagnose hearing levels of ear.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	--	M	S
CO2	S	--	--	--	--	--	--	--	M	--	--	M	M	M	S
CO3	S	--	--	--	--	--	--	--	M	--	--	M	M	M	S
CO4	S	S	M	M	S	M	--	--	M	--	--	S	M	M	S
CO5	S	S	M	M	--	M	--	--	M	--	--	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Pacemaker
2. Defibrillator
3. Haemodialysis
4. Heart Lung machine
5. PC based EEG
6. Audiometer
7. Roller Heart Pump
8. Study of Ventilator
9. Study of Anaesthesia machine
10. Study of Drug delivery system

REFERENCES:
Department Lab Manual

COURSE DESIGNERS

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17BMSE20	THERAPEUTIC EQUIPMENTS LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE
To enable the students to know about the various Therapeutic Equipment's.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Understand the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
2	Learn some of the cardiac devices.
3	To study the respiratory system using spirometer
4	To operate the Shortwave diathermy, Ultrasound diathermy and Surgical diathermy.

COURSE OUTCOMES

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

CO1. Discuss working principle of heart lung machine, Hemodialysis Model and ventilators.	Understand
CO2. Demonstrate pacemaker and defibrillator.	Apply
CO3. Analyze the respiratory system using spirometer	Analyze
CO4. Illustrate the Shortwave diathermy, Ultrasound diathermy and Surgical diathermy.	Analyze
CO5. Evaluate the electrical safety measurement	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	--	--	--	--	--	--	--	--	M	--	M	M
CO2	S	--	--	--	--	--	--	L	M	--	--	M	--	M	M
CO3	S	M	--	--	--	--	--	M	M	--	--	M	M	S	S
CO4	S	M	M	M	--	M	--	M	M	--	--	M	M	S	S
CO5	S	S	M	M	--	S	--	M	M	--	--	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Pacemaker Module
2. Defibrillator Simulator
3. Respiratory system analysis using Spirometer
4. Shortwave Diathermy
5. Ultrasound Diathermy

6. Surgical Diathermy
7. Study of heart lung machine
8. Study of Hemodialysis Model
9. Study of ventilators
10. Electrical safety measurements

REFERENCES:

Department Lab Manual

COURSE DESIGNERS

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17BMSE21	QUALITY CONTROL IN BIOMEDICAL ENGINEERING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of learning this course on troubleshooting and quality control in medical equipments for biomedical engineering students is to provide knowledge about the troubleshooting of various equipments used in hospitals and quality standard of medical equipment.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know the Fundamental Troubleshooting Testing Procedures.
2	To understand the Fault Diagnosis in Analog & Digital Integrated Circuits.
3	To learn the Biomedical Equipment Troubleshooting.
4	To understand the Medical Device Design Quality.
5	To learn the Design for Six Sigma and Medical Device Regulation.

COURSE OUTCOMES

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

CO1. Apply the common troubleshooting procedures in electronic equipment.	Apply
CO2. Outline the testing procedures of active and passive components.	Analyze
CO3. Categorize the fault diagnosis in analog circuits and digital ICs.	Analyze
CO4. Analyze the problems in common biomedical equipment in hospitals.	Analyze
CO5. Grade the various quality measures & standards adapted for medical.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	M	--	--	--	--	M	--	--	S	M	M	M
CO2	S	S	S	M	--	M	--	--	S	--	--	S	M	M	M
CO3	S	S	S	M	--	M	--	--	S	--	--	S	M	M	M
CO4	S	S	S	M	--	M	--	--	S	--	--	S	M	M	M
CO5	S	S	S	S	M	S	--	--	S	--	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTAL TROUBLESHOOTING TESTING PROCEDURES

Equipment failure and its causes, Functional block diagram of a troubleshooting system, Troubleshooting process & fault finding aids, Troubleshooting techniques and their correction action, Testing of active and passive components: resistor, capacitor, inductor, BJT, JFET & MOSFET.

FAULT DIAGNOSIS IN ANALOG & DIGITAL INTEGRATED CIRCUITS
Characteristics of ideal op-amps, typical op-amp based medical circuits, Fault diagnosis in op-amp circuits Digital troubleshooting methods, Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator.

BIOMEDICAL EQUIPMENT TROUBLESHOOTING
Troubleshooting - ECG Machine, EEG Machine, Troubleshooting - defibrillator, electrosurgical unit. Troubleshooting - anesthesia machine, autoclaves & sterilizers. Troubleshooting - endoscope, incubators, nebulizer. Troubleshooting - oxygen concentrators, sphygmomanometers, suction machine, Troubleshooting - X-ray machine.
.
MEDICAL DEVICE DESIGN QUALITY
Definition of quality, essence of quality, Quality operating system and the device life cycle, Evolution of quality, Business excellence: a value proposition, Health care quality

DESIGN FOR SIX SIGMA AND MEDICAL DEVICE REGULATION
Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF), Medical device safety, medical device quality management systems requirements, Medical device regulation throughout the product development life cycle, Purpose of ISO 9001:2001&ISO 13485.

TEXT BOOKS:

1. Khandpur R S, **“Troubleshooting Electronic Equipment- Includes Repair & Maintenance”**, Tata McGraw-Hill, 2nd Edition, 2009.
2. Basem S EL-Haik& Khalid S Mekki, **“Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness”**, John Wiley & Sons, 1st Edition, 2008.

REFERENCES:

1. Nicholas Cram & Selby Holder, **“Basic Electronic Troubleshooting for Biomedical Technicians”**, TSTC Publishing, 2nd Edition, 2010.
2. Dan Tomal & Neal Widmer, **“Electronic Troubleshooting”**, McGraw Hill, 3rd Edition, 2004.
3. World Health Organisation, **“Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment”**, Geneva, 1994.
4. Ian R McClelland, **“X-ray Equipment maintenance & repairs workbook for Radiographers & Radiological Technologists”**, World Health Organisation, Geneva, 2004.
5. Ministry of Health &Family Welfare, **“Medical Equipment Maintenance Manual- A first line maintenance guide for end users”**, New Delhi, 2010.

COURSE DESIGNERS

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17BMSE22	CRITICAL CARE INSTRUMENTS AND THERAPEUTIC EQUIPMENT	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course is designed to enable students to understand the principles of monitoring of respiratory, cardiovascular and other systems of the patients in ICU. Many diagnostic and therapeutic devices such as ventilators, hemodialysis, pacemakers, infusion pumps, and deep-brain or spinal stimulators attempt to augment or, in some cases, replace certain critical physiological functionalities.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe the basic principles of monitoring system.
2	To identify the benefits and risks of ICU monitoring techniques.
3	To describe the functions of Pacemaker and defibrillator.
4	To understand the functions of therapeutic equipment.
5	To study ventilators and drug delivery systems.

COURSE OUTCOMES

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

CO1. Examine the critical care instruments.	Apply
CO2. Solve the critical situation.	Apply
CO3. Use the diathermy systems.	Apply
CO4. Illustrate hemodialysis and lithotripter techniques.	Analyze
CO5. Infer ventilator and drug delivery systems.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	--	M	--	L	M	S	M	--	--	S	M	M	S
CO2	S	S	--	M	--	L	M	S	M	S	--	S	M	M	S
CO3	S	S	--	M	--	L	--	--	M	--	--	S	M	M	M
CO4	S	S	--	S	--	M	--	--	S	--	--	S	M	S	M
CO5	S	S	--	S	--	M	--	--	S	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

CRITICAL CARE MONITORING SYSTEM

Objective of critical care monitoring system, cardiac monitor, Bed side monitoring system, Central monitors, Cardiac arrhythmia, Arrhythmia monitor, ST/AR arrhythmia algorithm, Ambulatory monitoring instruments, Fetal monitoring.

CARDIAC PACEMAKER AND DEFIBRILLATOR
Need for pacemaker. External pacemaker, Implantable pacemaker. Types of implantable pacemaker, Pacing modes, ventricular synchronous demand pacemaker, Power sources for implantable pacemaker.
Defibrillator – Need for defibrillator, Dc defibrillator, Implantable defibrillator, Pacer – cardioverter defibrillator, Defibrillator analyser.

ELECTRO THERAPHY AND SURGICAL DIATHERMY
Short wave diathermy, Microwave diathermy, Ultrasonic theraphy Unit, Electrotherapy, Pain relief through electrical stimulation. Principles of surgical diathermy, Types of electro surgery techniques, Surgical diathermy machine, Coagulation modes, Mono polar and bipolar technique, Electrodes used with surgical diathermy, Surgical diathermy analyzers.

HAEMODIALYSIS AND LITHOTRIPTOR
Function of kidney, Artificial kidney, Types of dialyzers, Performance analysis of dialyzer, Hemodialysis machine, Portable Kidney Machine. Lithotripter- Stone disease problem, First lithotripter machine, Modern lithotripter systems.

VENTILATORS AND DRUG DELIVERY SYSTEMS
Mechanics of Respiration, Ventilators, Ventilator terms, Classification of ventilators, Modern ventilator. Humidifier, Nebulizers and Aspirator. Drug delivery systems – infusion pomp, components of infusion pump, implantable infusion systems, Examples of typical infusion pumps.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.
3. Arumugam, M, **"Biomedical Instrumentation"**, Anuradha publications, 2008.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation application and design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M **"Introduction to Biomedical equipment technology"**, John Wiley and sons, New York, 4th Edition, 1997.

COURSE DESIGNERS

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17BMSE23	MEDICAL WASTE MANAGEMENT	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To learn more about managing medical waste, Health Care and its necessary.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand the process of managing medical waste.
2	To educate awareness among the various Medical Establishments producing Bio-Medical Waste regarding the hazardous effects of Bio-Medical Waste and necessity of compliance of Bio-Medical Waste
3	To create awareness among people associated with different local bodies and healthcare units about the necessities and requirements for scientific segregation, storage, treatment and disposal of Bio-Medical Waste
4	To Make available treatment & disposal of Bio-Medical Waste in Most scientific manner at a reasonable cost & to comply all the rules of the Bio-Medical Waste Management.
5	To understand modern technologies for managing medical waste.

COURSE OUTCOMES

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

CO1: Summarize the history of waste management including impacts from early human civilization to current day.	Understand
CO2: Describe the major categories of waste.	Understand
CO3: Illustrate waste collection, recycling, and materials recovery techniques for MSW.	Apply
CO4: Characterize the components and chemical and physical properties of medical waste.	Analyze
CO5: Classify requirements for hazardous waste generation, transportation, treatment, storage, and disposal.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	--	--	M	S	S	S	--	--	S	--	M	S
CO2	S	M	M	--	--	M	S	S	S	--	--	S	--	M	S
CO3	S	S	M	--	--	S	S	S	S	L	M	S	M	M	S
CO4	S	S	M	--	--	S	S	S	S	M	M	S	--	M	S
CO5	S	S	M	--	--	S	S	S	S	M	M	S	--	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
General Introduction, Definition of Biomedical Waste, General and Hazardous health care waste – Colour Coding and types of containers for disposal of medical waste, Segregation, Collection & Disposal.

BIOMEDICAL WASTES
Infectious waste, Genotoxic waste, Waste Sharps – Categories, Categorization and composition of Biomedical waste. Liquid Biomedical Waste - Radioactive wastes, Metals, Chemicals & drugs.

BLOOD PRODUCTS
Human Blood and Blood Products, pathological wastes, Contaminated sharps, Contaminated animal carcasses, body parts, and bedding Basic information about infection, Infectious agents on organizations spread of infection, Basic information about Hospital acquired infection.

STERILISATION
Disinfections unit container for Autoclaving, Sharp waste containers for storage & transportation, autoclaving, Incineration, Plasma Pyrolysis / Gasification systems, Composting.

MODERN TECHNOLOGY FOR MEDICAL WASTES
Modern Technology for handling Biomedical Wastes – Monitoring & Controlling of Cross Infections, Protective Devices – Bioethics and Handling of Waste Management.

TEXT BOOK:

1. V. J. Landrum, **"Medical Waste Management and disposal"**, Elsevier, 1991.

REFERENCES:

1. Malhotra A., **"Hospital Management: An Evaluation"**, Global India Publications, 2009.
2. S L Goel, **"Hospital Management"**, Deep and Deep Publications, 2010.
3. J Glyn Hendry & Gary W Heinke, **"Environmental Science and Engineering"**, Prentice Hall India, 2004.
4. Shyam Divan, **"Environmental law and policy in India"**, Oxford India Press, 2004.
5. Charles A Wentz, **"Hazardous Waste Management"**, McGraw Hill Inc, Newyork, 1995.

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17BMSE24	MEDICAL TECHNOLOGY AND ENTREPRENEURSHIP	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of learning this course on medical technology and entrepreneurship for biomedical engineering students is to acquire knowledge and understand the advanced in medical equipments in therapeutic, diagnostic and entrepreneurship.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To impart the knowledge about the Home Medicare in various clinical application.
2	To make the students understand the active control trials in the evaluation of new treatments.
3	To impart the knowledge about Legal issues and Health policies related to Biosciences.
4	To study the minimally invasive device and technique used in medical devices.
5	To get knowledge about the advances in healthcare technologies and wireless technology related to healthcare system.

COURSE OUTCOMES

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

CO1. Explain the system description of different therapeutic & diagnostic equipments.	Understand
CO2. Use the ethical and regulatory guidance.	Apply
CO3. Categorize healthcare technologies and wireless technology related to healthcare system.	Analyze
CO4. Illustrate the advancement in medical technologies.	Analyze
CO5. Support entrepreneurial products for medical applications.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	--	--	--	M	M	--	--	S	M	S	M
CO2	S	S	M	M	--	M	--	S	S	--	--	S	S	S	M
CO3	S	S	S	M	M	M	--	M	S	--	--	S	S	S	M
CO4	S	S	S	S	M	S	--	M	S	M	--	S	S	S	S
CO5	S	S	S	S	M	S	S	M	S	M	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

SYSTEM DESCRIPTION OF THERAPEUTIC EQUIPMENT

Pacemaker, External cardiovector defibrillator, Implantable cardiovector defibrillator, Deep brain stimulation, Functional electrical stimulator (FES), Hemodialysis delivery system, Mechanical ventilator.

SYSTEM DESCRIPTION OF DIAGNOSTIC EQUIPMENT
Patient monitoring system, ECG, EEG, Blood pressure monitor, Digital stethoscope, Thermometer, System description and diagram of pulse oximeter, optical fiber optics for circulatory and respiratory system measurement.

ETHICAL AND REGULATORY GUIDANCE
Immobilization, The Nurenberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule, Code of federal regulations

WIRELESS TECHNOLOGY
Wireless communication basics – Types of wireless network, Body area network – Emergency rescue – Remote recovery – General health assessments Technology in medical information processing – Future trends in healthcare technology.

ADVANCEMENT IN MEDICAL TECHNOLOGIES
Advances and trends in health care technologies – Driver impacting the growth of medical Technologies – Impact of Moore's law of medical imaging – E-health and personal healthcare – Defining the future of health Technology – Inventing the future – tools for self health – Future of nano fabrication molecular scale devices – Future of telemedicine – Future of medical computing.

TEXT BOOKS:

1. Ezekiel J, Emanuel, Robert A Crouch, John D Arras, Jonathan D Moreno, Christine Grady, **"Ethical and Regulatory Aspects of Clinical Research"**, Johns Hopkins University Press, First Edition, 2003.
2. Kenneth J. Turner, **"Advances in Home Care Technologies: Results of the match Project"**, Springer, 2011.

REFERENCES:

1. Anthony Y. K, Chan, **"Biomedical Device Technology: Principles and Design"**, Charles Thomas, 2008.
2. Theodore R, Kucklick, **"The Medical Device Ramp-D Handbook"**, Taylor & Francis Group LLC, 3rd Edition 2013.

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17BMSE25	ACTION PLAN DEVELOPMENT AND INTERVENTION	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The healthcare industry is currently hemorrhaging knowledge capital from its nursing ranks. Capital is one of the most important assets to any organization. While experience is a difficult asset to measure in terms of monetary value it is in many cases; easy to identify in the operational execution aspects.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To provide a structured approach to developing and designing a work plan.
2	To systematically monitor progress towards a target.
3	To set the stage for measuring performance and identifying opportunities for improvement.
4	To succinctly communicate intended impact and current progress to stakeholders.

COURSE OUTCOMES

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

CO1. Understand the importance of planning in healthcare management.	Understand
CO2. Describe the difference between strategic and operational planning.	Understand
CO3. Examine the eight stages of operational planning, as they relate to healthcare management.	Apply
CO4. Illustrate various practices followed in operation theatre.	Analyze
CO5. Recommend Eminent services in hospitals.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	--	--	--	S	--	M	S	--	--	S	M	S	S
CO2	S	M	--	--	--	S	--	M	S	--	--	S	S	S	S
CO3	S	S	S	M	--	S	--	S	S	M	--	S	S	S	S
CO4	S	S	S	S	M	S	--	S	S	S	--	S	S	S	S
CO5	S	S	S	S	S	S	--	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

HOSPITAL PLANNING

Concept of Planning – Guiding Principles in Planning Hospital Facilities and Services – Regional Planning and Factors to be emphasized – Steps in Hospital Planning; Planning Team and Stages of Project – Estimation, Architect Brief and Master Plan – Selection of Site and Decision on Land, Space and Utilities.

OUTPATIENT SERVICES

Objectives – Functions – Location, Design and Layout –Policy and Procedures – Organization – Staffing – Equipment and Facilities – Key Result Areas and Performance / Quality Indicator – Daily Planning and Scheduling of Work – Managing Time: Waiting Time and Total Time Spent by a Patient – Specialty, Sub-specialty and Super Specialty Clinics – Diagnosis, Physiotherapy and Occupational Therapy- Emerging Concepts: Day Care, Reservation, Appointment by Phone- Medico-social Works / Patient Counseling – Other Facilities: Pharmacy, Gifts Shop, Prayer / Meditation Room.

TRAUMA CARE: EMERGENCY AND CASUALTY SERVICES
Objectives – Functions – Location, Design and Layout – Policy and Procedures – Organization – Staffing – Equipment and Facilities – Key Result Areas and Performance / Quality Indicators – Disaster Management: Principles and Classification – Life Saving Drugs – Ambulance and Paramedic Services – Medico-legal Procedures – Forms and Registers to be maintained – Communication System.

INPATIENT SERVICES
Objectives – Functions – Location, Design and Layout – Policy and Procedures – Organization – Staffing-Equipment and Facilities – Key Result Areas and Performance / Quality Indicators- Admission, Transfer, Billing and Discharge Procedures- Managing Deaths- Intensive Care Units, Objectives, Functions, Location, Design and Layout, Policy and Procedures, Organization, Staffing, Equipment and Facilities, Key Result Areas and Performance / Quality Indicators- Types of ICUs.

OPERATION THEATRE
Equipment and Facilities – Key Result Areas and Performance / Quality Indicators – Daily Planning and Scheduling – Determinants of number of Operating Rooms – Zoning and Aseptic / Sterile Techniques Clinical Protocols – Sub-stores, CSSD, Immediate Postoperative Recovery Rooms – Safety Issues.

TEXT BOOKS:

1. R. Llewelyn Davies and HMC Macaulay, **"Hospital Planning and Administration"**, Jaypee Brothers Medical Publishers P. Ltd., New Delhi
2. B.M. Sakharkar, **"Principles of Hospital Administration and Planning",** Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

REFERENCES:

1. NHS, **"Guide to Good Practices in Hospital Administration"**, Department of Health and Social Security: National Health Services, London.
2. Syed Amin Tabish, **"Hospital and Health Services Administration Principles and Practice"**, Oxford University press, New Delhi.
3. C.M. Francis and et al., **"Hospital Administration"**, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
4. G.D. Kunders, **"Designing for Total Quality in Health Care"**, Prism Books Pvt. Ltd., Bangalore.

COURSE DESIGNERS

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17BMSE26	LAB VIEW DESIGN FOR MEDICAL SYSTEM AND IMAGING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE
To impart adequate knowledge on LAB view for acquisition and analysis of medical signals and imaging in medical system.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To educate about the Basic concepts of LAB view.
2	To make them understand the programming concepts of LAB view
3	To provide an insight to various Common Instrument Interface.
4	To enable them to implement LAB view in medical signals and imaging.
5	To impart knowledge on various analysis tools.

COURSE OUTCOMES

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

CO1. Explain the basic architecture, needs and advantages of LAB view.	Understand
CO2. Demonstrate the programming mode like structure, loop and function in LAB view environment.	Apply
CO3. Outline the common interface instruments used in LAB view.	Apply
CO4. Analyze various analysis tools and its applications in LAB view.	Analyze
CO5. Categorize the hardware system suitable for virtual instrumentation in medical application.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	S	--	S	--	M	--	--	--	S	S	S	S	M
CO2	S	M	S	M	S	--	M	--	M	--	S	S	S	S	M
CO3	S	M	S	M	S	--	M	--	M	--	S	S	S	S	S
CO4	S	S	S	S	S	--	S	--	M	--	S	S	S	S	S
CO5	S	S	S	S	S	--	S	--	M	--	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO VIRTUAL INSTRUMENTATION
Virtual instrumentation (VI): Evolution, Definition, Architecture- Conventional-, and Distributed- VI, Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques, graphical programming, Comparison between graphical programming and conventional programming, VI in engineering process.

PROGRAMMING MODES IN VI
VI: front panel, Block diagram, LABVIEW Environment: Startup, Shortcut, and Pull down menu, Palletes, Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes, Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters, Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

HARDWARE ASPECTS OF VI SYSTEM
Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers, data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software.

COMMON INSTRUMENT INTERFACE
Current loop:4-20mA,60mA, RS232, RS422, RS485, General purpose interface bus(GIPB) ,Virtual Instrument Software Architecture (VISA), Universal serial port bus(USB), Peripheral computer interface (PCI), VME extensions for instrumentation (VXI), PCI extensions for Instrumentation (PXI), Personal Computer Memory Card International Association (PCMCIA), Signal conditioning extension for instrumentation (SCXI).

ANALYSIS TOOLS AND APPLICATIONS OF VI
Fourier transform, Power spectrum, Correlation, Windowing, filtering, Oscilloscope, Waveform generator, Multi-channel data acquisition using LABVIEW, ECG acquisition for long term monitoring of heart rate using VI.

TEXT BOOKS:
1. Gary Jonson, **"Labview Graphical Programming"**, Fourth Edition, McGraw Hill, New York, 2006.
2. Lisa K wells & Jeffrey Travis, **"Labview for everyone"**, Prentice Hall Inc, New Jersey, First Edition, 1997.

REFERENCES:

1. Gupta S J, Gu.pta P, **"PC interfacing for Data Acquisition & Process Control"**, Instrument Society of America, Second Edition, 1994.

COURSE DESIGNERS

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17BMSE27	MEDICAL IMAGING EQUIPMENTS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To acquire knowledge about the various medical imaging techniques and to understand the fundamental principle and working of the medical imaging equipments involved in the diagnosis of health care.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn the different methods and modalities used for medical imaging.
2	To learn the preferred medical imaging methods for routine clinical applications.
3	To understand the engineering models used to describe and analyze medical images.
4	To apply these tools to different problems in medical imaging.
5	To practice methods used to analyze medical images.

COURSE OUTCOMES

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

CO1. Discuss the working principles of imaging equipments.	Understand
CO2. Demonstrate the Image acquisition in X-Ray, MRI, CT, Ultrasound and other imaging equipments.	Apply
CO3. Analyze the reconstruction techniques in PET, SPECT and other imaging techniques.	Analyze
CO4. Illustrate various medical imaging equipments like thermography, IR imaging, OCT, etc.,	Analyze
CO5. Compare different medical imaging equipments in various operating modes.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	--	--	--	M	S	S	--	--	L	M	M	M	M
CO2	S	S	L	M	--	M	S	S	S	--	M	S	S	M	M
CO3	S	S	M	S	M	S	M	S	S	--	M	S	S	M	S
CO4	S	S	M	S	M	S	M	S	S	--	M	S	S	M	S
CO5	S	S	M	S	S	S	L	S	S	M	M	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

X-RAY AND CT IMAGING

Principles and production of soft X-rays and hard X-rays – Details of radiographic and fluoroscopic images in X-Ray systems – Screen-film and image intensifier systems – Evolution of CT machines – CT image formation – Conversion of X-ray data into scan image, Mathematical details of various algorithms- spiral CT, Transverse tomography – CT

Angiography

PET AND SPECT IMAGING

Introduction to emission tomography, basic physics of radioisotope imaging Compton cameras for nuclear imaging, PET scanner principles, SPECT, Computer techniques in fast acquisition Analytic image reconstruction techniques, Attenuation, scatter compensation in SPECT spatial compensation in SPECT.

MAGNETIC RESONANCE IMAGING

Image acquisition in magnetic resonance imaging MRI-T1, MRI-T2 proton density weighted images spin-echo technique and spin relaxation technique – MRI artifacts – Various types of pulse sequences for fast acquisition of imaging, NMR spectroscopy.

ULTRASOUND IMAGING

Physics of ultrasound – Principles of image formation, capture and display – Principles of A-Mode, B-Mode, M-Mode-Scan converters – Frame grabbers – Single line and multi-line monitoring of ultrasound displays – US artifacts.

OTHER IMAGING EQUIPMENTS

Infrared (IR) imaging: Thermography – Clinical applications of thermography, liquid crystal thermography. Optical coherence tomography (OCT): Introduction and its medical applications- Advances in image resolutions and speed in picture archiving and communication systems (PACS) in medical imaging.

TEXT BOOKS:

1. Khandpur R.S, **“Hand-book of Biomedical Instrumentation”**, Tata McGraw Hill, 2^{nd} Edition, 2003.
2. William R, hendee E, Russell Ritenour, **“Medical imaging physics”**, Fourth Edition, 2002.

REFERENCES:

1. Leslie Cromwell, Fred J, Weibell, Erich A, Pfeiffer, **“Bio medical Instrumentation and Measurements”**, Prentice-Hall of India, 2^{nd} Edition, 1997.
2. Wolfgang Drexler James G, Fijimoto, **“Optical coherence tomography technology and applications”**, Springer, First Edition, 2008.

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17BMSE28	NANO TECHNOLOGY IN MEDICINE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE
To study about Nano materials, fundamentals of nano technology & applications of Nanotechnology.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know about the concept of Nanotechnology.
2	To study about the fundamentals of Nanoscience.
3	To study about materials and properties used for MEMS & NEMS.
4	To know about the medical use of nanomaterials.
5	To study about the medical applications.

COURSE OUTCOMES

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

CO1. Describe the basic science behind the properties of materials.	Understand
CO2. Explain the basics properties of NEMS.	Understand
CO3. Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.	Apply
CO4. Outline the applications of nanomedicine.	Analyze
CO5. Analyze the biomolecular components like nanotubes with nanotechnology.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	--	L	--	M	L	S	S	--	--	S	S	M	M
CO2	S	M	--	L	--	M	L	S	S	--	--	S	S	M	M
CO3	S	S	--	M	--	M	L	S	S	--	--	S	M	M	M
CO4	S	S	M	S	--	L	L	S	S	--	--	S	M	S	M
CO5	S	S	M	S	--	L	L	S	S	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Introduction to Nanotechnology: Nanomaterials, Fullerenes and carbon forms. Nanoparticles and Colloids, structure and bonding in nanoparticles, Nanomaterials fabrication by Bottom-up and Top down approaches, Classification of nanodevices based on the characteristics, Quantum dots and their properties.

FUNDAMENTALS OF NANOSCIENCE
Size dependence of properties – Particle size determination – Bulk to nanotransition – Semiconducting nanoparticles – Carbon nanostructures – Mechanical properties (hardness, ductility, elasticity) – Optical properties of nanotubes – Electrical properties of nanotubes.

MEMS & NEMS
Definition of MEMS, materials for MEMS (Silicon, Polymers and metals) and their properties, Deposition processes, Photolithography, and etching processes, Limitations of MEMS, NEMS, difference between MEMS and NEMS, properties of NMES, fabrication processes, applications.

NANOMEDICINE
Nanomedicine: Medical use of Nanomaterials, Drug delivery systems. Cancer treatment, Surgery. Drug tracking systems. Targeted drug delivery systems.Applications of Nanomaterials in Medical imaging. Neuro-electronic interfaces.

BIO MOLECULAR NANOTECHNOLOGY
Nanorobots and their application, nanosensors based on biomolecules such as DNA and proteins, nanoparticles for gene delivery systems, Computational genes, Biosensors for Glucose and measurement, Optical biosensors and their application ,Preparation of Nanosystems: Introduction to nanolithography – Carbon nanotubes: preparation – Synthesis and preparation of nanomaterials (crystalline and thinfilm) **-** Physical and chemical methods **-** Control and stability (size, shape, composition).

TEXT BOOKS:

1. Lynn E. Foster, Foreword by George Allen, Foreword by Joe Lieberman, **"Nanotechnology**'.
2. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., **"Introduction to Nanoscale Science and Technology"**, Springer publications, 2004.

REFERENCES:

1. Chattopadhyay, **"Introduction to Nanoscience and Nanotechnology"**, PHI, 2009.
2. B.k. Parthasarathy, **"Nanoscience and Nanotechnology"**, Gyan Books, 2007.

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17BMSE29	MEDICAL IMAGING LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE

Understand medical diagnostic image reconstruction and enhancement techniques using MATLAB.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To develop programming and problem solving in real time system.
2	To develop industrial competent people.
3	To improve their ability in medical image analysis and system design.

COURSE OUTCOMES

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

CO1. Apply filtering and detection techniques to images.	Apply
CO2. Implement reconstruction techniques.	Apply
CO3. Compare the detection techniques.	Analyze
CO4. Evaluate Miller's Algorithm and Cooley -Turkey Algorithm.	Analyze
CO5. Create algorithm for Low Pas filter, High Pass Filter and Median Filter.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	S	M	S	S	M	M	--	--	S	M	S	M
CO2	S	S	M	M	L	S	M	M	M	--	--	S	M	S	M
CO3	S	S	S	M	--	L	M	L	S	--	--	S	S	S	M
CO4	M	S	S	--	--	L	M	L	S	--	--	S	S	S	M
CO5	M	S	S	--	--	L	L	L	S	M	M	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Algorithms for Low Pas filter, High Pass Filter, Median Filter
2. Prewitt Edge, Quick Edge Detector
3. Miller's Algorithm
4. Cooley -Turkey Algorithm
5. Point Detection.
6. Line Detection.
7. Edge Detection.
8. Reconstruction Algorithm for Parallel and Fan Beam Projections.

9. Back Projection Algorithm.
10. A.R.T. (Algebraic Reconstruction Techniques).
11. S. A. R. T. (Simultaneous Algebraic Reconstruction Technique)
12. S. I. R T (Simultaneous Iterative Reconstruction Technique)
13. Image Enhancement – Histogram.

REFERENCE:

1. **"MATLAB with signal processing and image processing toolboxes".**

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17BMSE30	GRAPHICAL SYSTEM DESIGN FOR BIOMEDICAL ENGINEERS	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE
The purpose of the course on graphical system design for biomedical engineers for biomedical engineering students is to enhance their knowledge and educate graphical system on real time system development using Lab VIEW.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To develop professionals with practical knowledge.
2	To study the sharpening of ECG, EEG and EMG signals.
3	To develop industrial competent people.
4	To improve their ability in embedded system design.
5	To develop programming and problem solving in real time system.

COURSE OUTCOMES

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

CO1. Examine the biological signal in real-time data acquisition system.	Apply
CO2. Demonstrate the hardware and software data acquisition system.	Apply
CO3. Analyze the communication between RT target, FPGA and HOST.	Analyze
CO4. Outline the full prototype model of a biomedical system.	Analyze
CO5. Create and investigate a physiological data like ECG, EEG, EMG and biomedical signal.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	--	M	M	S	S	M	M	--	--	S	M	M	M
CO2	S	S	--	M	L	S	M	M	M	--	--	S	M	M	S
CO3	S	S	M	M	--	M	M	M	S	M	M	S	S	M	S
CO4	S	S	M	--	M	M	M	M	S	M	M	S	S	M	M
CO5	S	S	S	S	S	M	S	S	S	M	S	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

1. Graphical System Design Software Platform Lab VIEW
2. Developing modular applications - Managing file and hardware resources
3. Implementing design patterns
4. Overview of a DAQ system

5. Bio-medical signal conditioning
6. Getting started with LabVIEW Field-Programmable gate array (FPGA)
7. Programming using Lab VIEW FPGA - Synchronizing FPGA loops and I/O
8. Sharing physiological data like ECG, EEG on FPGA
9. Communicating between the FPGA and host
10. Creating and investigating a NI myRIO project
11. Exploring the myRIO FPGA personality
12. Communication between RT target and HOST
13. Development of full prototype model of any biomedical system

TEXT BOOKS:

1. Nasser Kehtarnavaz, **"Digital Signal Processing System – Level Design Using LabVIEW"**, Newnes0- 7506-7914-X, 2005.
2. Leonard Sokoloff, **"Applications in LabVIEW"**, Prentice Hall, 0-13-833949-X, 2003.

REFERENCES:

1. Jaakko Malmivuo & Robert Plonsey, **"Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields"**, Oxford University Press, New York, 1995.

COURSE DESIGNERS

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17ECCC18	INTERNET OF THINGS FOR ELECTRONICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The purpose of this course is to impart knowledge on Internet of Things (IoT), which relates to the study of sensors, actuators, and controllers, among other Things, IoT applications and examples overview (building automation, transportation, healthcare, industry, etc.) with a focus on wearable electronics

PREREQUISITE - Nil

COURSE OBJECTIVES

1	Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved
2	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
3	Market forecast for IoT devices with a focus on sensors
4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi
5	To study the advanced internet of things for electronics

COURSE OUTCOMES

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

CO1. Explain the concept of Internet of Things.	Understand
CO2. Explain the IOT Sensors To Appear	Apply
CO3. Design and implement of technological sensors	Analyze
CO4. Design and implement applications using internet of things	Analyze
CO5. Explain the advanced internet of things used in different applications.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	-	L	-	-	-	-	-	-	M	-	-	-
CO2	L	S	S	-	M	-	-	-	-	-	-	M	-	-	-
CO3	S	M	M	-	L	M	-	-	-	-	-	M	S	M	-
CO4	S	L	L	-	L	S	-	-	-	-	-	M	S	M	M
CO5	M	M	S	-	M	L	-	-	-	-	-	M	-	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Internet of Things Promises–Definition–Scope–Sensors for IoT Applications–Structure of IoT–IoT Map Device

SEVEN GENERATIONS OF IOT SENSORS TO APPEAR

Industrial sensors –Description & Characteristics–First Generation –Description & Characteristics–Advanced Generation –Description & Characteristics–Integrated IoT Sensors –Description & Characteristics–Polytronics Systems –Description & Characteristics–Sensors' Swarm –Description & Characteristics–Printed Electronics –Description & Characteristics–IoT Generation Roadmap

TECHNOLOGICAL ANALYSIS

Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

IOT DEVELOPMENT EXAMPLES

ACOEM Eagle –EnOcean Push Button –NEST Sensor –Ninja Blocks -Focus on Wearable Electronics

PREPARING IOT PROJECTS

Creating the sensor project -Preparing Raspberry Pi -Clayster libraries -Hardware-Interacting with the hardware -Interfacing the hardware-Internal representation of sensor values -Persisting data -External representation of sensor values -Exporting sensor data -Creating the actuator project-Hardware -Interfacing the hardware -Creating a controller -Representing sensor values -Parsing sensor data -Calculating control states -Creating a camera -Hardware -Accessing the serial port on Raspberry Pi -Interfacing the hardware -Creating persistent default settings -Adding configurable properties -Persisting the settings -Working with the current settings -Initializing the camera

REFERENCE BOOKS:

1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Développement Copyrights ,2014

2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

3. Editors OvidiuVermesan Peter Friess,'Internet of Things –From Research and Innovation to Market

4. Deployment', River Publishers, 2014
5. N. Ida, Sensors, 'Actuators and Their Interfaces', Scitech Publishers, 2014.
6. Qusay F. Hassan,'Internet of things a to z: technologies and applications' ,John Wiley and Sons Ltd,2018

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17ECCC06	ELECTRONICS MEASUREMENT AND INSTRUMENTATION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To understand the Basic concepts of electronic measurements, Signal Generator and Analysers, Transducers, Data Acquisition Systems and Fiber Optic Measurements.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To familiarize with the basic concepts of measurement and the related instrumentation Systems.
2	To impart knowledge on Electronic measurements and calibration of instruments.
3	To learn the concepts in signal generators and signal analyzers in measurements.
4	To introduce various Data acquisition systems, Transducers, and fiber optic power measurements.

COURSE OUTCOMES

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

CO1. Identify errors in different types of electronic measurements.	Understand
CO2. Determine the unknown values of capacitance and inductance using AC bridges.	Apply
CO3. Explain concepts and circuit construction of various Analog & Digital voltage measurement methods.	Apply
CO4 Illustrate different signal generators and frequency synthesizer	Analyze
CO5. Analyze the various elements in data acquisition systems and fiber optic measurements.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	-	L	-	-	-	M	-	-	-	M	-	-
CO2	S	M	M	-	L	-	-	-	M	-	-	-	-	-	-
CO3	S	M	M	-	L	-	-	-	M	-	-	-	-	-	-
CO4	S	M	M	-	L	-	-	-	M	-	-	-	S	M	M
CO5	S	M	M	-	L	-	-	-	M	-	-	-	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC MEASUREMENT

Measurement and error – Units and standards of measurements – Permanent Magnet Moving Coil Mechanism – DC Ammeters, Voltmeters Multimeters, Ohmmeter, AC Indicating Instruments, Thermo instruments, Electrodynamometers, Watt-hour meter. Bridge measurements –Wheatstone, Kelvin, Maxwell, Hay, Schering, and Wien bridge.

BASIC ELECTRONIC MEASUREMENTS

Amplified DC Meter, AC Voltmeter using rectifiers, True RMS Responding Voltmeter, Electronic Multimeter, Consideration in Choosing an Analog Voltmeter, Digital Voltmeters-Ramp, Integrating, Successive approximation. Q meters – RF voltage and power measurements. Cathode ray oscilloscopes – block schematic – Special oscilloscopes–Storage Oscilloscope, Sampling Oscilloscope, Digital Storage Oscilloscopes

SIGNAL GENERATORS AND ANALYZERS

Function generators – RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer.

FREQUENCY COUNTERS AND TRANSDUCERS

Simple Frequency Counter, Measurement Errors, Extending the frequency range, Automatic and computing counters. Classification of Transducers, Selecting a Transducer, Strain gauges, Displacement Transducers, Temperature Transducers, and Photosensitive Devices.

DATA ACQUISITION SYSTEMS AND FIBER OPTIC MEASUREMENTS

Elements of digital data acquisition system – interfacing of transducers – multiplexing – IEEE 488 bus – fiber optic measurements-Sources and Detectors-Fiber Optic Power measuring- Light sources – Optical time domain reflectometer.

TEXT BOOKS:

1. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India, 2008

REFERENCES:

1.Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, 2nd Edition Pearson education, 2009.

2. Alan. S. Morris, Principles of Measurements and Instrumentation, Prentice Hall of India, 2nd edn.,2003.

3. Ernest O. Doebelin, Measurement Systems- Application and Design-Tata McGraw-Hill- 2004.

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4	Mr. S. Selvam	Assistant Professor (Gr-II)	ECE	selvam@avit.ac.in

17ECCC11	DATA COMMUNICATION NETWORKS	Category	L	T	P	Credits
		CC	3	0	0	3

PREAMBLE

To introduce the concepts of communication networks, in depth understanding of network architecture of different layers of data communications and its security protocols.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the physical layers of layered models.
2	To be exposed to error detection/correction & medium access controls.
3	To be familiar with Internet Protocols & current scenario
4	To understand the concepts of Transport & Application layers.
5	To be familiar with Network & Internet security.

Course Outcomes

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

CO1. Understand the basics and working of layered architecture	Understand
CO2. Differentiate different error control, Link control, access control and different LAN Technologies. Also to evaluate merits and demerits	Apply
CO3. Explain the role of protocol and design it for appropriate routing mechanism.	Analyze
CO4. Analyze the various transport and application layer protocols in real time.	Analyze
CO5. Study the functioning and methods of data and network security.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M	-	-	L	-	-	-	L	-	-	L	-	-	-
CO2	S	S	L	-	M	-	-	-	-	L	-	-	S	-	-
CO3	S	S	M	-	-	-	-	-	M	L	L	-	S	M	-
CO4	S	S	L	-	-	-	-	L	L	L	L	L	M	M	M
CO5	M	L	L	-	L	-	-	M	M	-	-	M	M	M	-

S- Strong; M-Medium; L-Low

Syllabus

Physical Layer.

Data Communications-Networks & its types-Standards-Networks models –Protocol layering-TCP / IP protocol suite-OSI model.

Digital to Digital conversion-Analog to Digital conversion-Transmission modes-Digital to Analog conversion-Analog to Analog conversion-Multiplexing-Spread spectrum-Guided and Unguided Transmission media-Switching-Circuit switched networks-Packet switching-Structure of Switch.

Data Link Layer.

Link layer addressing.

Error Detection & Correction: Block coding-Cyclic codes-Checksum-Forward error correction. Data link control: DLC services-Data link layer protocols-HDLC-PPP.

Medium Access Control: Random access-Controlled access-Channelization.

Wired LANS: Ethernet protocol-Standard Ethernet-Fast Ethernet & Gigabit Ethernet.

Wireless LANS: IEEE 802.11 project-WiMAX-Cellular Telephony-Satellite networks.

Connecting devices, Virtual LANS.

Network Layer.
Network layer services-Packet switching-Performance-IPv4 Addresses.
Internet Protocol, ICMPv4, Mobile IP.
Unicast Routing: Routing algorithms-Unicast routing protocols.
Multicast routing: Multicasting basis-Intra domain & Inter domain Multicast protocols, IGMP.
Next Generation IP: IPv6 Addressing-IPv6 protocol-ICMPv6 protocol-Transition from IPv4 to IPv6.

Transport & Application Layer
Transport layer protocols-User Datagram Protocol-Transmission Control Protocol-SCTP.
Client server programming-WWW & HTTP-FTP-Electronic mail-TELNET-SSH-DNS-SNMP-Compression-Multimedia Data & in the Internet- Real-Time Interactive protocol-P2P Networks-CHORD-PASTRY-KADEMLIA-BITTORNET.

Network & Internet Security
Quality of Service: Data flow characteristics-Flow control to improve QoS-Integrated services-Differentiated services.
Cryptography: Introduction-Confidentiality-Other aspects of Security.
Internet Security: Network layer security-Transport layer security-Application layer security-Firewalls.

TEXT BOOK:

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill, 2013.

REFERENCE BOOKS:

1. 1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2011.
2. James F. Kurose, Keith W. Ross, "Computer Networking- A Top -Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
3. Larry L. Peterson, Bruse S. Davie, "Computer Networks: A System Approach",Fifth Edition, Morgan Kaufmann Publishers, 2011.
4. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.

Course Designers

S.No	Name of the Faculty	Designation	Department	e-Mail ID
1	Dr. D. Vijendra Babu	Professor	ECE	vijendrababu@avit.ac.in
2	Mr. R. Karthikeyan	Assistant Professor (Gr-II)	ECE	rrmdkarthikeyan@avit.ac.in
3	Mr.B.Rajasekaran	Associate Professor	ECE	rajasekaran@vmkvec.edu.in
4	Mr.G.Sureshkumar	Assistant Professor	ECE	sureshkumar@vmkvec.edu.in

17ECCC15	ANALOG & DIGITAL COMMUNICATION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This course provides a thorough introduction to the basic principles of Analog and Digital Communications. It also deals with Analog and Digital Modulation techniques, Communication Transmitter & Receiver design, Baseband and Bandpass Communication Techniques, Noise Analysis and Multiplexing techniques.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To Understand the basic elements of analog communication system
2	To learn the basic concepts behind the transmission and reception of Angle Modulation
3	To impart the knowledge about Analog to Digital Transition Systems &Information Theory
4	To Analyze & design the performance of various digital carrier transmission.
5	To Apply the knowledge of Digital Communication circuits in various fields.

COURSE OUTCOMES

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

CO1.Interpret the various Analog communication systems.	Understand
CO2.Illustrate the principle and operation behind various Modulators , Demodulators in Analog communications	Apply
CO3. Apply different coding theory to estimate Entropy, Mutual information, Information rate etc.	Apply
CO4.Demonstrate the concept of various digital carrier modulation and determine their error probability.	Apply
CO5.Analyze the major classifications of spread spectrum techniques .	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	L	-	-	-
CO2	S	M	M	-	M	-	-	-	-	-	-	M	S	M	M
CO3	S	M	M	M	-	-	-	-	-	-	-	M	S	-	-
CO4	S	S	M	M	-	-	-	-	-	-	-	M	M	M	-
CO5	S	M	M	M	L	-	-	-	-	-	-	L	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Analog Communication Systems

Principles of Amplitude Modulation – AM Modulators- Double Side Band Suppressed Carrier Modulation, Single Side Band Modulation, Vestigial Side Band Modulation, AM Demodulators,AM transmitters-Low level & High level Transmitters, AM Receivers – TRF, Super Heterodyne Receiver, Double conversion AM receivers.

Angle Modulation: Transmission And Reception

Angle Modulation - FM and PM, Modulation Index, Frequency Modulators and Demodulators, Phase Modulators, FM transmitters- Direct & Indirect transmitters, Angle Modulation Vs Amplitude Modulation, FM Receivers, Frequency Vs Phase modulation.

Analog to Digital Transition Systems & Information Theory

Pulse Amplitude Modulation, Pulse Position Modulation, Pulse Code Modulation, Sampling Rate, DPCM, Delta Modulation, Time Division Multiplexing, Information Theory- Uncertainty, Information and entropy, source coding theorem, Discrete Memoryless channels, Mutual Information, Channel capacity, Channel coding theorem.

Digital Transmission

Pulse Transmission – Inter Symbol Interference, Eye pattern, Digital carrier Modulation-Binary Amplitude Shift Keying, Binary Frequency Shift Keying, Binary Phase Shift Keying, QPSK, bit and baud rate, BER Analysis

Spread Spectrum Modulation

Pseudo noise sequences, Direct sequence Spread Spectrum with coherent BPSK, Frequency hop spread spectrum modulation, Multiple Access Techniques – Wireless Communication, TDMA and FDMA

TEXT BOOK:

1. Simon Haykin and Michael Moher, "Communication systems" John Wiley & Sons, Fifth Edition, 2016

REFERENCE BOOKS:

1. Simon Haykin and Michael Moher, "An Introduction to Analog and Digital Communications", John Wiley & Sons, second Edition, 2006.
2. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, PHI, 2002
3. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", Pearson Education, 2001.
4. B. Carlson, "Introduction to Communication systems", 3rd Edition, McGraw Hill, 1989

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.B.Rajasekaran	Associate Professor	ECE	rajasekaran@vmkvec.edu.in
2	Mrs.S.Valarmathy	Associate Professor	ECE	valarmathy@vmkvec.edu.in
3	Mr.P.Subramanian	Associate Professor	ECE	subramanian@avit.ac.in

17ECCC16	MICROWAVE & OPTICAL COMMUNICATION SYSTEMS (THEORY & PRACTICE)	Category	L	T	P	Credit
		CC	2	0	2	3

PREAMBLE

Microwave pertains to the study and design of Microwave circuits, Components, and systems. Fundamental principles are applied to Analysis, Design and Measurement techniques in this field. Also to gain knowledge about different types of Optical Emission, Detection Communication Systems and their Applications. This course makes the students to be familiar with the microwave and optical Measurements.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To learn the terminology used in Microwave transmission system, Microwave components and their S-Parameters and its application in various fields
2	To learn the various Microwave sources, semiconductor devices and IC's.
3	To measure different parameters at microwave frequencies
4	To know the basics of solid state physics and understand the nature and characteristics of light And optical sources and amplifiers
5	To learn the principle of optical detection and mechanism in different detection devices.

COURSE OUTCOMES

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

CO1. Summarize the principles of Microwaves and Fiber Optics in Communication System.	Understand
CO2. Demonstrate the various Microwave Sources and Semiconductor Devices.	Apply
CO3. Illustrate the different parameter measurements in Microwave Engineering.	Apply
CO4. Outline the optical fibers and sources used for Communication System.	Analyze
CO5. Analyze the optical detectors and amplifiers used for Communication Systems in different applications.	Analyze
CO6. Evaluate the performance of given antenna and RF filters by applying radio frequency	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	-	-	-	-	-	-	-	M	-	-	-	-	-
CO2	S	S	S	-	-	-	-	-	M	M	M	M	-	-	-
CO3	S	S	S	-	-	-	-	-	M	M	M	M	-		M
CO4	S	S	-	M	-	-	-	-	-	M	-	M	S	M	-
CO5	S	S	M	M	-	-	-	-	M	M	M	M	M	M	M
CO6	S	S	S	M	S	M	M	M	M	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MICROWAVES, COMPONENTS AND THEIR S-PARAMETERS

Microwave history, spectrum and band characteristics of microwaves-a typical microwave system. Applications of

Microwaves: Traditional, industrial and biomedical fields, S-matrix – significance, formulation and properties. S-matrix representation of a multi port network, Waveguide Attenuators, Waveguide Multi port Junctions- E plane and H plane Tees, Magic Tee, and Hybrid Ring, Directional Couplers, Isolator, Circulator- S-matrix calculations.

MICROWAVE SOURCES-O AND M-type TUBES,SEMICONDUCTOR DEVICES AND IC'S

Microwave tubes: O-type – Two cavity Klystron Amplifier, Reflex Klystron oscillator, M-type – cross-field effects, Magnetrons- types, HELIX TWT- types and characteristics of slow wave structures, structure of TWT and amplification process, Avalanche Transit Time Devices- principle of operation and characteristics of IMPATT and TRAPATT diodes, Schottky Barrier Diodes, IC'S:Monolithic Microwave Integrated Circuits (MMIC), MIC materials-Types.

MICROWAVE MEASUREMENTS

Power, Frequency and impedance measurement at microwave frequency, Network Analyzers and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure.

INTRODUCTION -OPTICAL FIBERS AND OPTICAL SOURCES

Introduction to vector nature of light, Basic optical Laws and Definitions, Optical Fiber Modes and Configurations, Single Mode Fibers and Graded- Index Fiber Structures, Fiber Materials, Attenuation- Absorption, Scattering Losses, Bending Losses, Core and Cladding Losses, Optical sources - LED and LASER diode - Principles of operation

OPTICAL DETECTORS AND AMPLIFIERS

Principal of Photodiodes, Types of Optical detectors –PN Photodiode, PIN Photodiode, Avalanche photodiode, Phototransistor, semiconductor Laser Amplifiers, Erbium-Doped Fiber Amplifier, Raman Fiber amplifier, Brillouin Fiber amplifier ,Applications of Optical Amplifiers, Noise in Optical Amplifiers.

RF PRACTICE

Directivity ,Gain and Radiation pattern measurement for dipole, loop and Yagi - Uda antenna - RF Filters.

TEXT BOOKS:

1. Samual Y.Liao, "Microwave Devices and Circuits", PHI, 3rd Edition, 2003.
2. Collin R.E., "Foundation of Microwave Engineering", McGraw Hill, 2nd Edition, 2009.
3. Keiser. G, "Optical fiber communications", 4th Edition Tata McGraw-Hill, New Delhi, 2008
4. Franz & Jain, "Optical communication, Systems and Components", Narosa Publications, New Delhi, 2000.

REFERENCE BOOKS:

1. Microwave Principles – Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS Publishers and Distributors, New Delhi, 2004.
2. Peter A.Rizzi, "Microwave Engineering – Passive Circuits", PHI Publications.
3. Chatterjee.R, "Elements of Microwave Engineering", Affiliated East-West Press Pvt. Ltd.
4. John Gowar, "Optical Communication Systems", 2nd Edition Prentice Hall, 1993.
5. Agrawal. G.P, "Fiber-Optic Communication Systems" 3rd Edition John Wiley & Sons, 2002.

COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.D.Vijendra Babu	Professor	ECE	vijendrababu@avit.ac.in
2	Mrs.S.Valarmathy	Associate Professor	ECE	valarmathysr@vmkvec.edu.in

17ECCC17	FPGA SYSTEM DESIGN	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Field programmable devices are able to match the functional complexity of ASIC Devices such as PROM, PLDs (PLAs, PALs). PALs were widely used for glue logic and replaced SSI and MSI devices. Complex PLD‟s are hierarchical PLD‟s that connects smaller PLD‟s through a central programmable interconnect to enable the implementation of medium complexity digital circuits. Main feature of CPLDs are the wide decoding, but has a low register to logic ratio. CPLD‟s architecture is not scalable, due to the central switch used in connecting small PLD structures. Digital designs once built in custom silicon are increasingly implemented in field programmable gate arrays (FPGAs), but effective FPGA system design requires a understanding of new techniques developed for FPGAs. This course deals FPGA fabrics, introduces essential FPGA concepts, and compares multiple approaches to solving basic problems in programmable logic.

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To analyze the design principle of synchronous and asynchronous circuits.
2	To design complex programmable logic by analyzing the FPGA architecture.
3	To know the functional operation of various components of FPGA logics.
4	To expertise in VHDL programming.

COURSE OUTCOMES

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

CO1. Analysis, Design and Optimisation of the sequential digital systems.	Understand
CO2. Illustrate the FPGA architecture- logic cell, I/O cell and interconnects	Analyze
CO3. Design Complex Programmable Logic Devices for specific applications	Analyze
CO4. Discriminate the functional operation of various components of FPGA logics	Analyze
CO5. Design new logical design using VHDL programming	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	S	M	M	M	L	-	M	-	-	-	-	M	S	-	-
CO2	S	M	S	L	M	-	-	-	-	-	-	M	M	M	-
CO3	S	S	S	S	L	-	M	-	-	-	L	M	-	-	M
CO4	S	M	L	L	L	-	-	-	-	-	-	M	-	-	-
CO5	M	S	S	S	S	L	M	-	-	-	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Sequential Circuit Design using state machine approach

Synchronous and Asynchronous Sequential Circuit -Finite State Machine- Moore and Mealy, State Diagram, State table, State Assignment, Optimization of sequential circuit – State Minimization – Determination of state equivalence using an implication table,Races and Hazards.

Programmable Logic to ASICs

Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PALs), the Masked Gate Array ASIC, CPLDs and FPGAs.

Complex Programmable Logic Devices

CPLD Architectures, Function Blocks, I/O Blocks, Clock Drivers, Interconnect CPLD Technology and Programmable Elements.

FPGA Systems

Basic Concepts, Digital Design and FPGAs, FPGA-Based System, VLSI Technology-Manufacturing Processes, Transistor Characteristics, CMOS logic gates, Wires, Registers and RAM, Packages and Pads, FPGA Fabrics-FPGA Architectures, SRAM-Based FPGAs, Permanently Programmed FPGAs, Chip I/O, Circuit Design of FPGA Fabrics, Architecture of FPGA Fabrics

Hardware Description Language VHDL

Introduction to VHDL, structural, functional programming, Combinational Logic-Combinational Network Delay, Power and Energy Optimization, Arithmetic Logic, Logic Implementation for FPGAs, Physical Design for FPGAs, Sequential Machines-Sequential Design Styles, Rules for Clocking, Performance Analysis, Power Optimization.

TEXT BOOKS:

1. Charles H.Roth Jr, Larry L.Kinney "Fundamentals of Logic Design", Seventh edition, Cengage Learning 2014.
2. Jan M. Rabey, Anantha Chandrakasan and Borivoje Nikolic " Digital integrated circuits: A Design Perspective (2nd Edition) ", Pearson 2009

REFERENCE BOOKS:

1. Wayne Wolf "FPGA –Based System Design" Pearson Education, 2004.
2. Bob Zeidman, "Designing with FPGAs and CPLDs", Elsevier, CMP Books, 2002.
3. M. Morris Mano and Michael D. Ciletti, "Digital Design", PHI, fourth edition, 2008
4. R.F.Tinder: Engineering Digital Design, (2/e), Academic Press, 2000
5. Stephen Brown Zvonko Vranesic "Fundamentals of Digital Logic with VHDL Design" Tata McGraw-Hill Edition.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.T.Muthumanickam	Professor	ECE	muthumanickam@vmkvec.edu.in
2	Dr. L. K. Hema	Professor	ECE	hemalk@avit.ac.in
3	Dr.T.Sheela	Associate Professor	ECE	sheela@vmkvec.edu.in
4	Mr. S. Selvam	Assistant Professor (Gr-II)	ECE	Selvam@avit.ac.in

17ECEC21	ADVANCED ROBOTICS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE Advanced Robotics will explore in great depth areas relevant to not only industrial robotics but service robots (i.e. robots outside a factory environment particularly mobile robots) and the application of this technology to real world environments e.g. driverless vehicles, unmanned aerial vehicles and tele-robots. Students will also master robot kinematics and dynamics.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To gain knowledge in robotic elements
2	To explore the kinematics of serial and parallel robotics
3	To know the motion of robot in various coordinates and surfaces

COURSE OUTCOMES

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

CO1. Illustrate the kinematics of parallel robotics	Apply
CO2. Examine about the kinematics of serial robot such as the direct and inverse kinematic problems	Apply
CO3. Discriminate various robotic elements like sensors and actuators	Analyze
CO4. Investigate the motion of robot in various coordinates	Analyze
CO5. Explore the motion of robot in several surfaces like flat surface, uneven terrain	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	-	-	-	M	-	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	M	S	-	M
CO3	S	S	S	-	-	-	-	M	-	-	-	M	-	-	-
CO4	S	S	S	-	-	-	-	M	-	-	-	M	S	M	M
CO5	S	S	S	-	-	-	-	M	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Elements of robots -- joints, links, actuators, and sensors

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Kinematics of serial robots

Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.

Kinematics of parallel robots

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Motion planning and control

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.

Modeling and analysis of wheeled mobile robots

Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.

Reference Books

1. Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.
2. Fu, K., Gonzalez, R. and Lee, C.S. G., Robotics: Control, Sensing, Vision and Intelligence¸McGraw- Hill, 1987.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.L.K.Hema	Professor	ECE	hemalk@avit.ac.in
2	N.Manikanda Devarajan	Assistant Professor	ECE	manikandadevarajan@vmkvec.edu.in
3	G.Murali	Assistant Professor	ECE	muraligvmkvec@vmkvec.edu.in

17ECEC23	MACHINE VISION	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

In the current automated world, Machine Vision plays a major role in several significant applications such as imaging-based automatic inspection and analysis, Intelligent transportation system, Logistics, Robot guidance, Packaging industries and many. It provides an detailed view of the various process involved.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To understand the Image filtering operations, Morphological operationsThreholding Images.
2	To determine the concepts of Binary shape & Boundary Pattern analysis, Detection & Pattern matching techniques.
3	To examine the concepts of 3-D Vision, Image Transformations & Motion.
4	To illustrate the automated visual inception, in vehicle vision systems, inspection of cereal grains & surveillance.

COURSE OUTCOMES

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

CO1.Intrepret the Low Level Vision techniques and methods of Machine Vision	Understand
CO2.Demonstrate the Intermediate Level Vision techniques.	Apply
CO3.Paraphase the 3-D Vision and Motion procedures.	Apply
CO4.Infer the various Real-Time Pattern Recognition systems.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	-	-	-	-	-	-	-	-	S	M	-
CO2	S	S	M	L	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	M	L	-	-	-	-	-	-	-	-	M	M	-
CO4	S	S	S	M	-	-	-	-	-	-	-	-	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS:

LOW-LEVEL VISION

Images and Imaging Operations, Basic Image Filtering Operations, Thresholding Techniques, Edge Detection, Corner and Interest Point Detection, Mathematical Morphology, Texture

INTERMEDIATE-LEVEL VISION

Binary Shape Analysis, Boundary Pattern Analysis , Line Detection, Circle and Ellipse Detection, The Hough Transform and Its Nature, Pattern Matching Techniques

3-D VISION AND MOTION

The Three-Dimensional World, Tackling the Perspective n-point Problem, Invariants and Perspective, Image Transformations and Camera Calibration, Motion

REAL-TIME PATTERN RECOGNITION SYSTEMS

Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, Statistical Pattern Recognition, Image Acquisition, Real-Time Hardware and Systems Design Considerations

TEXT BOOK

1. Computer and Machine Vision: Theory, Algorithms, Practicalities,E.R.Davies,Fourth Edition,2012,Academic Press, Elsevier

REFERENCE BOOKS

1. Computer Vision: Algorithms and Applications, Richard Szeliski,Springer,2010
2. Machine Vision Algorithms and Applications, C Steger, M Ulrich Christian Wiedemann, Wiley-VCH, 2007, ISBN: 3527407340.
3. Hands-On Algorithms for Computer Vision, Amin Ahmadi Tazehkandi, Packt, 2018, ISBN:9781789130942

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Dept	Mail ID
1	Dr.D.Vijendra Babu	Professor	ECE	vijendrababu@avit.ac.in
2	Mr.P.Subramanian	Associate Professor	ECE	subramanian@avit.ac.in
3	Dr.T.Muthumanickam	Professor	ECE	muthumanickam@vmkvec.edu.in

17EEEC18	RENEWABLE ENERGY TECHNOLOGY	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

This course helpful for the students to enhance their knowledge in renewable sources and empower the students to understand the need of renewable source, utilization of techniques and its advantages. Energy is a vital input for the development and economic growth of a country. The growth for energy sector is critical for socio-economic development particularly for rural areas. Students will be exposed to the status of energy resources, its interaction with environment, different renewable energy sources technologies, different techniques and technologies for energy management and energy conservation along with the economic aspects of renewable energy based power generation. It is to provide specialist manpower to meet the challenges of the energy sector.

PREREQUISITE

- NIL

COURSE OBJECTIVES

1	To familiarize the student with the utilization methods of the renewable energy resources
2	To learn about PV Technology principles.
3	To learn economical and environmental merits of solar energy for variety applications.
4	To learn modern wind turbine control & monitoring.
5	To learn various power converters in the field of renewable energy technologies.
6	To study and Analyze different types of Power converters for Renewable energy conversion

COURSE OUTCOMES

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

CO1	Understand the various PV technologies	Understand
CO2	Implement The PV technology to various applications.	Apply
CO3	Assess the control and monitoring systems	Analyse
CO4	Realize modern control methods of wind turbine	Understand

CO5	Analyze various power converters.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	-	-	M	M	-	-	L	-	M	M	-	-
CO2	L	-	L	M	M	-	-	L	M	-	L	M	-	M	M
CO3	S	S	L	-	M	L	-	-	L	L	-	-	S	M	S
CO4	L	M	-	L	S	-	M	-	L	-	-	M	M	S	S
CO5	S	L	S	M	M	-	-	-	-	M	M	-	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

SOLAR THERMAL TECHNOLOGIES

Principle of working, types, design and operation of - Solar heating and cooling systems – Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying. Principle of working, types, design and operation of - Solar heating and cooling systems – Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

SPV SYSTEM DESIGN AND APPLICATIONS

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE) [VARIABLE SPEED VARIABLE FREQ.]

Excited Rotor Synch. Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits

MODERN WIND TURBINE CONTROL & MONITORING SYSTEM

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor &Blade), FACTS control & LVRT & New trends for new Grid Codes.

POWER CONVERTERS

Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

TEXT BOOK

1.Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, Taylor and Francis,2000

2.Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, 1996

3. Renewable Energy Sources and Emerging Technologies, Kothari, Prentice Hall India Learning Private Limited; 2 edition (2011), ISBN-10: 8120344707, ISBN-13: 978-8120344709

REFERENCES

1. Sukhatme S P, J K Nayak, Solar Energy – Principle of Thermal Storage and collection, Tata McGraw Hill, 2008.

2. Solar Energy International, Photovoltaic – Design and Installation Manual – New Society Publishers, 2006

3.Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1983

4. John D Sorensen and Jens N Sorensen, Wind Energy Systems, Woodhead Publishing Ltd, 2011

5. Rashid .M. H "power electronics Hand book", Academic press, 2001.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	e-Mail ID
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17EEEC20	**MATHEMATICAL MODELLING AND SIMULATION**	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Introduce the students to study the fundamentals of computing and modeling software environments for electrical engineering. This Course contains Programming in numerical computing and modeling software environments for electrical engineering. No prior programming experience or knowledge of SCILAB is assumed, and the course is structured to allow thorough assimilation of ideas through hands-on examples and exercises.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To study basic concepts of scientific programming using SCILAB.
2	To learn about the Basics of Program of SCILAB and related Mathematical Applications.
3	Analyze the concepts of Program of SCILAB.
4	To understand the different tools in SCILAB and ODE, DAE
5	To apply a software program to Electrical circuits and solve the simulation based solutions.

COURSE OUTCOMES

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

CO1	Understand the main features of the SCILAB program development environment to enable their usage in the higher learning.	Understand
CO2	Understand the need for simulation/implementation for the verification of mathematical functions.	Understand and Analyze
CO3	Implement simple mathematical functions/equations in numerical computing environment such as SCILAB.	Analyze
CO4	Interpret and visualize simple mathematical functions and operations thereon using plots/display.	Create and Apply
CO5	Analyze the program for correctness and determine/ estimate/ predict the output and verify it under simulation environment using SCILAB tools	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			L		L		L			L	L	M		M
CO2	M		L	M		M		L		L		L	-	S	
CO3	S	M	L		L		L	L	M	M	L		S	M	M
CO4	S	M	M	L	M	M	M		S	M	M	M	M	M	S
CO5	S	S	L	M	M	L	S	L	M	S	S	L	S	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to SCILAB – Constants – Data types – SCILAB Syntax – Data type related functions – Over loading.

GRAPHICAL ANALYSIS USING SCILAB

The media – global plot parameters – 2D and 3D plotting – examples – printing graphics and exporting to Latex.

SCILAB PROGRAMMING

Linear algebra – Polynomial and rational function manipulation – Sparse matrices – random numbers – cumulative distribution functions and their inverse – building interface programs – inter SCI – dynamic linking – static linking.

SCILAB TOOLS

Systems and control toolbox – improper systems – system operation – control tools classical control – state space control – model reduction – identification – linear matrix inequalities – integrating ODEs – integrating DAEs.

APPLICATIONS

Resistive circuits – inductive and capacitive circuits – transients – steady state analysis – logics circuits – electronic devices - DC machines

TEXT BOOK

1. Claude Gomez Engineering and Scientific Computing with SCILAB, Birkhauser publications
2. Scilab: A Practical Introduction to Programming and Problem Solving, Tejas Sheth, CreateSpace Independent Publishing Platform, 2016, ISBN : 1539027848, 9781539027843

REFERENCES

1. **Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications**A. Vande Wouwer, P. Saucez, C. V. Fernández 2014ISBN: 978-3319067896

2. SCILAB(a Free Software to Matlab), Er. HemaRamachandran and Dr. Achutsankar Nair, S. Chand Publishers, ISBN-10: 8121939704,2011

3. http://in.mathworks.com/

4.https://www.scilab.org/resources/documentation/tutorials

5. **http://www.scilab.org/**

COURSE DESIGNERS

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17EEEC21	**NON CONVENTIONAL ENERGY SOURCES**	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Non Conventional sources of energy are generally renewable sources of energy. This type of energy sources include anything, which provides power that can be replenished with increasing demand for energy and with fast depleting conventional sources of energy such as coal, petroleum, “natural gas etc. The non- conventional sources of energy such as energy from sun, wind, biomass, tidal energy, geo thermal energy and even energy from waste material are gaining importance. This energy is abundant, renewable, pollution free and eco-friendly. It can also be more conveniently supplied to urban, rural and even remote areas. Thus, it is also capable of solving the twin problems of energy supply in a decentralized manner and helping in sustaining cleaner environment. It concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications

PREREQUISITE

- NIL

COURSE OBJECTIVES

1	To impart the knowledge of basics of different non conventional types of power generation & power plants
	To understand the need and role of Non-Conventional Energy sources.
2	To learn economical and environmental merits of solar energy for variety applications.
3	To learn modern wind turbine control & monitoring.
4	To learn various power converters in the field of renewable energy technologies.
5	To study and analyse different types of Power converters for Renewable energy conversion

COURSE OUTCOMES

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

CO1	Identify the different non conventional sources and the power generation techniques to generate electrical energy.	Understand
CO2	Explore the Solar Radiation, different Methods of Solar Energy Storage and its Applications.	Analyse
CO3	Familiarize the Winds energy as alternate form of energy and to know how it can be tapped	Understand

CO4	Explore the Geothermal Energy Resources and its methods.	Understand
CO5	Identify the Bio mass and Bio gas resources and its tapping technique	Analyze
CO6	Investigate the Tidal, Wave and OTEC Energy, Concepts of Thermo-Electric Generators and MHD Generators	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	M	M	-	L	L	-	L	-	-	M	-	-	-
CO2	S	L	M	L	M	M	S	L	M	M	M	S	-	-	
CO3	-	M	M	S	L	M	L	-	-	L	S	-	M	M	S
CO4	M	L	-	-	-	S	-	S	S	L	M	S	S	S	M
CO5	-	M	L	M	L	L	M	L	S	M	S	L	S	M	S
CO6	L	-	-	-	-	-	M	-	S	S	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Statistics on conventional energy sources, Classification of Energy Resources, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources

SOLAR ENERGY CONCEPT

Introduction to Solar Energy - Radiation and its measurement, Solar Energy conversion and its types - Introduction to Solar Energy Collectors and Storage, Applications of Solar Energy: Solar Thermal Electric Conversion Systems, Solar Electric power Generation, Solar Photo-Voltaic, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation, Stand-alone, Grid connected solar power satellite

WIND ENERGY CONCEPT

Introduction - Basic Principles of Wind energy conversion-The nature of wind- The power in the wind (No derivations) - Forces on the Blades (No derivations)-Site Selection considerations-Basic components of a wind energy conversion system (WECS)-Advantages & Limitations of WECS-Wind turbines (Wind mill)-Horizontal Axis wind mill-Vertical Axis wind mill-performance of wind mills-Environmental aspects - Determination of torque coefficient, Induction type generators

GEOTHERMAL AND BIOMASS ENERGY

Geothermal Sources - Hydro thermal Sources - a. Vapor dominated systems b. Liquid dominated systems -Prime movers for geothermal energy conversion - Biomass Introduction - Biomass conversion techniques-Biogas Generation-Factors affecting biogas Generation-Types of biogas plants- Advantages and disadvantages of biogas plants-urban waste to energy conversion - MSW incineration plant.

.

TIDAL AND OTEC ENERGY

Tidal Energy-Basic Principles of Tidal Power-Components of Tidal Power Plants- Schematic Layout of Tidal Power house-Advantages & Limitations of Tidal, Wave, OTEC energy - Difference between tidal and wave power generation, OTEC power plants, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC.

TEXT BOOK

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.
3. Non Conventional Energy Resources, Shobh Nath. Singh, Pearson Education India, 2016, e – ISBN : 978933255906 - 6

REFERENCES

1. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
2. Wakil MM, Power Plant Technology, Mc Graw Hill Book Co, New Delhi, 2004.
3. Non – Conventional Energy Sources. Rai.

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17CSCC04	COMPUTER ARCHITECTURE	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE:

This course is dedicated to number system, logic design, and memory and processing. This is the only course that is concerned with the hardware of a computer, its logic design and organization. It aims at making the student familiar with digital logic and functional design of arithmetic and logic unit that is capable of performing floating point arithmetic operations.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To learn about the design of the processors.
2	To learn about the data transfer.
3	Understand the functional units of a computers, bus structures and addressing modes.
4	Apply the knowledge of algorithms to solve arithmetic problems.

COURSE OUTCOMES

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

CO1 Explain about computer organization components.	Understand
CO2 Compute simple arithmetic operations for fixed-point and floating-point addition, subtraction, multiplication & division.	Apply
CO3 Design combinational and sequential digital functions.	Analyse
CO4 Construct an instruction set capable of performing a specified set of operations.	Analyze
CO5 Demonstrate a memory system for a given set of specifications	Analyze
CO6 Explain pipelining concepts	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	M	-	-	-	-	-	-	-	L	M	-	-
CO2	M	M	M	M	-	-	-	-	-	-	-	L	M	-	-
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	-	-
CO4	S	M	M		-	-	-	-	-	-	-	-	M	M	M
CO5	S	-	M	L	-	-	-	-	-	-	-	-	M	M	M
CO6	M	M	M	S	-	-	-	-	-	-	-	L	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Computer Organization- Main memory – CPU operation – Interrupt concept – I/ O techniques – Bus concept – Computer performance factors – System performance measurement- High performance techniques – Comparison of Architecture and Organization – Study of Salient features and architectures of Advanced processors (80286, 80386, 80486, Pentium).

PROCESSOR DESIGN AND CONTROL UNIT

Goals – Design process –Data path organization – Main memory interface – Data path for single instructions- Floating point unit data path – Role of control unit – Reset sequence – Interrupt recognition and servicing – Abnormal situation handling – Hardwired control unit – Micro programmed control unit.

MEMORY DESIGN & MEMORY MANAGEMENT

Memory types – Functional and usage modes – Memory allocation- Multiple memory decoding – Memory hierarchy – Instruction pre fetch – Memory interleaving – Write buffer – Cache memory –Virtual memory – Associative memory.

INTRA SYSTEM COMMUNICATION AND I/O

I/O controller & driver- Case study: Hard disk controller in IBM PC – I /O ports and bus concepts – Case study: Keyboard interface – Bus cycle – Asynchronous and Synchronous Transfer – Interrupt handling in PC – I/O techniques in PC – Case Study : RS 232 interface – Modern serial I/O interface – Bus arbitration techniques – Hard disk interface in PC.

ADVANCED ARCHITECTURE

Classification of parallelism – Multiple functional units – Pipelining – Vector computing – array processors –High performance architecture – RISC systems – Super scalar architecture – VLIW architecture – EPIC architecture – Multiprocessor systems – Cache coherence problem – Fault tolerance.

TEXT BOOKS:

1. William Stallings, “Computer Organization And Architecture – Designing For Performance”, Sixth Edition, Pearson Education, 2007.

REFERENCES:

2. Govindarajulu, “Computer Architecture and Organization – Design principles and applications” , Tata McGraw Hill publications, New Delhi.
3. David A. Patterson And John L. Hennessy, “Computer Organization And Design: The Hardware/Software Interface”, Fifth Edition, Morgan Kaufmann, 2013.
4. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998.
5. A.K.Ray & K.M.Bhurchandi, “Advanced Microprocessors and peripherals- Architectures, Programming and Interfacing”, McGraw-Hill Education (India), 2013 reprint.

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17CSCC03	DATABASE MANAGEMENT SYSTEM	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE:

This course aims at facilitating the student to understand the various concepts and functionalities of Database Management Systems, the method and model to store data and how to manipulate them through query languages, the effective designing of relational database and how the system manages the concurrent usage of data in multi user environment.

PREREQUISITE:

NIL

COURSE OBJECTIVES

1	Describe a relational database and object-oriented database.
2	Create, maintain and manipulate a relational database using SQL.
3	Describe ER model and normalization for database design.
4	Examine issues in data storage and query processing and can formulate appropriate solutions.
5	Design and build database system for a given real world problem.

COURSE OUTCOMES

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

CO1. Illustrate the database design for applications and use of ER Diagram.	Understand
CO2. Build and manipulate the relational database using Structured Query Language and relational languages.	Apply
CO3. Develop a normalized database for a given application by incorporating various constraints like integrity and value constraints.	Apply
CO4. Apply concurrency control & recovery mechanism for database problems.	Apply
CO5. Construct data structures like indexes and hash tables for the fast retrieval of data.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	-	-	-	-	-	M	S	M	-	-
CO2	M	M	M	L	M	-	-	-	-	-	M	M	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	M	L	M	M	M
CO4	S	M	M	M	L	-	-	-	-	-	M	M	M	M	M
CO5	S	M	M	M	M	-	-	-	-	-	M	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Database System Applications - Views of data - Data Models - Database Languages -Modification of the Database - Database System Architecture - Database users and Administrator- Introduction to relational databases - Structure of Relational Databases - Entity-Relationship model (E-R model) - E-R Diagrams.

RELATIONAL APPROACH

The relational Model - Additional & Extended Relational - Types of Keys - Relational Algebra - Null Values - Domain Relational Calculus - Tuple Relational Calculus - Fundamental operations - Additional Operations- SQL fundamentals - Structure of SQL Queries - SQL Data Types and Schemas - Nested Sub queries - Complex Queries - Integrity Constraints - Triggers - Security - Advanced SQL Features - Embedded SQL- Dynamic SQL- Views - Introduction to Distributed Databases and Client/Server Databases..

DATABASE DESIGN

Overview of the Design Process - Functional Dependencies - Non-loss Decomposition - Functional Dependencies - Normalization and its Types - Dependency Preservation - Boyce/Codd Normal Form- Decomposition Using Multi-valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form - Entity Sets and its Types.

TRANSACTION &CONCURRENCY CONTROL

Transaction Concepts - Transaction State - Transaction Recovery - ACID Properties - System Recovery - Media Recovery - Two Phase Commit - SQL Facilities for recovery -Advanced Recovery Techniques - Buffer Management - Remote Backup Systems - Concurrency Control - Need for Concurrency - Locking Protocols -Two Phase Locking - Internet Locking - Deadlock Handling - Serializability - Recovery Isolation Levels - SQL Facilities for Concurrency.

STORAGE STRUCTURE

Introduction to Storage and File Structure - Overview of Physical Storage Media - Magnetic Disks - RAID - Tertiary storage - File Organization - Organization of Records in Files - Indexing and Hashing - Ordered Indices - B+ tree Index Files - B- tree Index Files - Bitmap Indices - Static Hashing - Dynamic Hashing -Query Processing - Catalogue Information for Cost Estimation – Selection Operation - Sorting - Join Operation - Query optimization - Database Data Analysis.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw-Hill Education; 6 edition, 2010).

REFERENCES:

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Pearson India; 7th edition, 2017, 2017).

2. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, Third Edition, McGraw Hill, 2002.

3. Carlos Coronel, Steven Morris , “Database Systems – Design, Implementation and Management, 13th Edition, Cengage Learning; 13th edition, 2018) .

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17CSCC19	INTERNET OF THINGS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To study and understand the technologies involved in Internet of Things (IoT) and apply them practically.

PREREQUISITE :NIL

COURSE OBJECTIVES

1.	To understand the basic concepts of IOT
2.	To study the methodology of IOT
3.	To Develop IOT applications using Raspberry PI
4.	To Develop IOT applications using Arduino and Intel Edison
5.	To apply cloud concepts in IOT

COURSE OUTCOMES

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

CO1: Able to understand basics in IOT	Understand
CO2: Able to understand Methodology in IOT	Apply
CO3: Able to design IOT applications using Raspberry	Analyze
CO4: Able to design IOT applications using Aurdino and Intel Edison	Analyze
CO5: Able to apply Cloud computing in IOT	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	M	S
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT vs M2M.
IOT METHODOLOGY
IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.
IOT WITH RASPBERRY
Bascis of Raspberry PI, Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services
IOT WITH AURDINO AND INTEL EDISON
Basics of Aurdino, Intel Edison with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks
APPLICATIONS
Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT.
TEXT BOOKS
1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. **2.** Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.
REFERENCES
1. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014

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17CSCC33	PROBLEM SOLVING USING COMPUTER	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This course is designed to introduce basic problem solving and program design skills that are used to create computer programs. It gives engineering students an introduction to programming and developing analytical skills to use in their subsequent course work and professional development. This course focuses on problem solving, algorithm development, top-down design, modular programming, debugging and testing using the programming constructs like flow-control, looping, iteration and recursion. It presents several techniques using computers to solve problems, including the use of program design strategies and tools, common algorithms used in computer program and elementary programming techniques.

PRERQUISITE

Nil

COURSE OBJECTIVES

1.	To understand the basic concepts of problem solving methodology.
2.	To study and apply algorithm design.
3.	To study and apply programming and developing skills.
4.	To understood, analyze and evaluate the problem.
5.	To apply, analyze, evaluate and solve the problem by using programming concepts.

COURSE OUTCOMES

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

CO1. Comprehend the role of computing and use of programming concepts in developing engineering solutions.	Understand
CO2. Develop algorithms to solve fundamental mathematical problems, merging, sorting and searching.	Apply
CO3. Develop algorithms for text processing and pattern searching	Analyze
CO4. Analyze a problem, identify the data in the problem, divide a problem into parts, solve individual parts using proper control structures and compose into an overall solution	Evaluate
CO5. Design algorithmic solutions to problems drawn from engineering contexts and implement using any structured programming language	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction to problem solving with computers - Computing Systems:

Hardware and Software – Engineering Problem Solving Methodology: problem specification and analysis, algorithm design, flowchart, implementation, program testing and verification.

Algorithm Design: Fundamental algorithms:

Swapping of two variables – counting – summation of set of numbers – factorial – Fibonacci sequence – base conversion Factoring Techniques: smallest divisor of an integer – greatest common divisor – generating prime number – generating prime factor

Merging, Sorting and Searching Techniques:

Two way merge – sorting by selection sort – sorting by exchange – sorting by insertion – linear search – binary search Array techniques: Array order reversal – Statistical measurement - array counting - array Partitioning Text Processing and Pattern Searching: Key word search – text line editing –linear pattern search.

Programming Concepts:

Basics of programming -Constant, variable, keywords, data types - Operators, operator precedence, expressions - Control Structures: Selection structure- Repetition Structure.

Modular Programming and Functions:

User defined functions- Recursive functions Array Handling: 1-D, 2-D: declaration – initialization, Using arrays as function arguments- Strings Pointers: Basics of Pointers - Arrays and Pointers - Pointers and Functions - Structures and Union - File Handling.

TEXT BOOK:

1. R. G. Dromey, “How to solve it by Computer”, Pearson Education India,2014

REFERENCES:

1. Maureen Sprankle, Jim Hubbard, “Problem Solving & Programming Concepts”,
2. Prentice Hall, 2012
3. Jeri R. Hanly - Elliot B. Koffman, “Problem Solving and Program Design in C”, 7th Edition, Pearson, 2013
4. Delores M. Etter, “Engineering Problem Solving with C”, Pearson, 4th Edition, 2013.
5. Donald E. Knuth, “Art of Computer Programming”, Pearson Education, 2012.
6. Yashavant Kanetkar, “Let us C”, 8th Edition, BPB Publications, 2007.

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17CSEC09	ETHICAL HACKING	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

To analyze the basic concepts of security and hacking process

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand Technical foundation of cracking and ethical hacking
2	To identify Aspects of security, importance of data gathering, foot printing and system hacking
3	To understand evaluation of computer security
4	To understand Practical tasks will be used to re-enforce and apply theory to encourage an analytical and problem based approach to ethical hacking
5	To discuss about security tools and its applications

COURSE OUTCOMES

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

CO1: Identify and analyse the stages an ethical hacker requires to take in order to compromise a target system.	Understand
CO2: Identify tools and techniques to carry out a penetration testing.	Understand
CO3: Critically analyze security techniques used to protect system and user data.	Apply
CO4: Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.	Apply
CO5: To apply information security features in real time	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	-	-	-	-	S	-	-	-	M	M	M	M	M
CO2	M	M	S	M	-	-	-	-	-	-	L	M	M	S	S
CO3	M	M	M	M	-	M	-	L	-	-	L	-	S	M	M
CO4	M	S	M	-	-	M	-	-	-	M	-	M	**M**	M	M
CO5	M	M	-	-	S	M	-	L	-	-	M	M	**M**	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to Hacking, Types of Hacking, Hacking Process, Security – Basics of Security- Elements of Security, Penetration Testing, Scanning, Exploitation- Web Based Exploitation. Simple encryption and decryption techniques implementation.

HACKING TECHNIQUES

Building the foundation for Ethical Hacking, Hacking Methodology, Social Engineering, Physical Security, Hacking Windows, Password Hacking, and Privacy Attacks, Hacking the Network, Hacking Operating Systems- Windows & Linux, Application Hacking, Footprinting, Scanning, and Enumeration. Implementing System Level Hacking- Hacking Windows & Linux.

WEB SECURITY

Evolution of Web applications, Web application security, Web Application Technologies- Web Hacking, Web functionality, How to block content on the Internet, Web pages through Email, Web Messengers, Unblocking applications, Injecting Code- Injecting into SQL, Attacking Application Logic. Check authentication mechanisms in simple web applications. Implementation of Web Data Extractor and Web site watcher. Implementation of SQL Injection attacks in ASP.NET.

WIRELESS NETWORK HACKING

Introduction to Wireless LAN Overview, Wireless Network Sniffing, Wireless Spoofing, Port Scanning using Netcat, Wireless Network Probing, Session Hijacking, Monitor Denial of Service (DoS) UDP flood attack, Man-in-the-Middle Attacks, War Driving, Wireless Security Best Practices, Software Tools, Cracking WEP, Cracking WPA & WPA-II. Implementation- Locate Unsecured Wireless using Net-Stumbler/ Mini-Stumbler.

APPLICATIONS

Safer tools and services, Firewalls, Filtering services, Firewall engineering, Secure communications over insecure networks, Case Study: Mobile Hacking- Bluetooth-3G network weaknesses, Case study: DNS Poisoning, Hacking Laws. Working with Trojans using NetBus.

TEXT BOOKS

1. Stuart McClure, Joel Scambray, George Kurtz, "Hacking Exposed 6: Network Security Secrets & Solutions", Seventh edition, McGraw-Hill Publisher, 2012.
2. Kevin Beaver, "Hacking for Dummies" Second Edition, Wiley Publishing, 2007.
3. Dafydd Stuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws" Wiley Publications, 2007.
4. Ankit Fadia, "An Unofficial Guide to Ethical Hacking" Second Edition, Macmillan publishers India Ltd, 2006.

REFERENCES

1. Hossein Bidgoli, "The Handbook of Information Security" John Wiley & Sons, Inc., 2005.

COURSE DESIGNERS

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17CSEC11	GREEN COMPUTING	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

To acquire knowledge to adopt green computing practices and To learn about energy saving practices

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To acquire knowledge to adopt green computing practices
2	To minimize negative impacts on the environment
3	To learn about energy saving practices
4	To learn about green compliance. And implementation using IT

COURSE OUTCOMES

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

CO1: Explain the significance knowledge to adopt green computing practices	Understand
CO2: Design and develop the green asset used to minimize negative impacts on the environment	Apply
CO3: Identify an appropriate cooling technologies and infrastructure for optimizing the cost of data center operations	Apply
CO4: Make use of an knowledge about energy saving practices ,the impact of e-waste and carbon waste	Apply
CO5: Analyze about green compliance, implementation using IT and derive the case study.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	S	-	-	-	M	-	-	-	-	-	**S**	S	S
CO2	S	S	M	-	L	-	S	S	-	M	-	M	S	S	S
CO3	S	M	M	-	-	M	S	M	-	-	-	-	M	M	M
CO4	S	S	-	-	-	-	S	S	-	M	-	M	M	M	M
CO5	S	M	M	-	-	S	M	-	M	-	M	S	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS

Green IT Fundamentals: Business, IT, and the Environment – Benefits of a Green Data Centre - Green Computing:Carbon Foot Print, Scoop on Power–GreenITStrategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

GREEN ASSETS AND MODELING

Green Assets: Buildings, Data Centres, Networks, Devices, Computer and Earth Friendly peripherals, Greening Mobile devices – Green Business Process Management: Modelling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

GRID FRAMEWORK

Virtualizing of IT Systems – Role of Electric Utilities, Telecommuting, Teleconferencing and Teleporting – Materials Recycling – Best Ways for Green PC – Green Data Center – Green Grid Framework. Optimizing Computer Power Management, Systems Seamless Sharing Across. Collaborating and Cloud Computing, Virtual Presence.

GREEN COMPLIANCE

Socio-Cultural Aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, And Audits – Emergent Carbon Issues: Technologies and Future. Best Ways to Make Computer Greener.

GREEN INITIATIVES WITH IT and CASE STUDIES

Green Initiative Drivers and Benefits with IT - Resources and Offerings to Assist Green Initiatives. - Green Initiative Strategy with IT - Green Initiative Planning with IT - Green Initiative Implementation with IT - Green Initiative Assessment with IT. The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

TEXT BOOKS

1.Bhuvan Unhelkar, ―Green IT Strategies and Applications-Using Environmental Intelligence‖,CRC Press, June 2011

2.Carl Speshocky, ―Empowering Green Initiatives with IT‖, John Wiley and Sons, 2010.

REFERENCES

1. Alin Gales, Michael Schaefer, Mike Ebbers, ―Green Data Center: Steps for the Journey‖, Shoff/IBM rebook, 2011.
2. John Lamb, ―The Greening of IT‖, Pearson Education, 2009.
3. Jason Harris, ―Green Computing and Green IT- Best Practices on Regulations and Industry‖, Lulu.com, 2008.

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17CSEC24	OPEN SOURCE SYSTEMS	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

The purpose of an open standard is to increase the market for a technology by enabling potential consumers or suppliers of that technology to invest in it without having to either pay monopoly rent or fear litigation on trade secret, copyright, patent, or trademark causes of action. No standard can properly be described as "open" except to the extent it achieves these goals.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Students will study common open source software licenses, open source project structure
2	To understand distributed team software development, and current events in the open source world
3	To learn free and open source components & tools
4	Students will also work on an open source project and will be expected to make a significant contribution

COURSE OUTCOMES

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

CO1: Explain common open source licenses and the impact of choosing a license	Understand
CO2: Analyze the open source project structure and how to successfully setup a project	Analyze
CO3 Apply the linux based user profile, file security, and file link and management.	Apply
CO4: Knowledge of free and open source tools like libre office, open office.	Apply
CO5: Apply the libre office- presentation like create, open, adding slide, text, background.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	-	L	-	-	-	-	-	-	S	-	M	M
CO2	S	M	M	-	M	-	-	-	-	-	-	M	M	M	M
CO3	S	M	M	M	-	-	-	-	-	-	-	M	M	M	M
CO4	S	S	L	M	M	-	-	-	-	-	-	M	M	-	M
CO5	S	M	L	M	-	-	-	-	-	-	-	M	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

OPEN SOURCE LICENSING

Open Source Licensing, Contract, and Copyright Law-The MIT, BSD, Apache, and Academic Free Licenses-The GPL, LGPL, and Mozilla Licenses-Qt, Artistic, and Creative Commons Licenses-Non-Open Source Licenses.

OPEN SOURCE OPERATING SYSTEM

Linux history-distributions-licensing-installing Linux-working with directories-working with files-working with file contents-the Linux file tree. shell expansion: commands and arguments-control operators-shell variables-file globing. Pipes and commands: I/O redirection-filters -regular expressions. Introduction to vi – scripting: scripting introduction-scripting loops-scripting parameters

LINUX USER MANAGEMENT

local user management- introduction to users-user management-user passwords-user profiles -groups. file security: standard file permissions-advanced file permissions-access control lists-file links.

LIBRE OFFICE –WORD, SPREAD SHEET

Introduction of libre office- WRITER — THE WORD PROCESSOR: Opening a Document -Laying Out the Page-Setting paper size, margins, and orientation -Creating headers and footers -Numbering pages -Entering and Editing Text-Modifying text-Moving and copying text.

CALC — THE SPREADSHEET: Creating a Spreadsheet -Inputting Your Data -Entering your data -Editing your data -Filling cells automatically -Managing Columns and Rows-Copying, pasting, cutting, dragging, and dropping your cells -Adding the Art -Formula Basics.

LIBRE OFFICE- PRESENTATION

IMPRESS — THE PRESENTATION Creating a Presentation -Opening an existing presentation -Adding Slides -Adding text to a slide -Saving Your Presentation for Posterity - Making Presentations Picture Perfect -Adding Images -Clipping art -Drawing objects -Coloring Backgrounds - Creating a plain-colored background -Creating a gradient background.

TEXT BOOKS

1. Understanding Open Source and Free Software Licensing By Andrew M. St. Lauren , August 2004 , Pages: 207. (Unit I)
2. Linux study link : https://itsfoss.com/learn-linux-for-free/ (Unit II & Unit III).
3. https://www.libreoffice.org/assets/Uploads/Documentation/en/GS51-GettingStartedLO.pdf (Unit IV & V)

REFERENCES

1. Andy channelle (2009), “Beginning OpenOffice 3”, Aprèss.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.
3. N. B. Venkateshwarlu (Ed); Introduction to Linux: Installation and Programming, B S Publishers; 2005.
4. Matt Welsh, Matthias Kalle Dalheimer, Terry Dawson, and Lar Kaufman, Running Linux, Fourth Edition, O'Reilly Publishers, 2002.
5. Carla Schroder, Linux Cookbook, First Edition, O'Reilly Cookbooks Series, 2004.

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17CSEC32	VIRTUAL REALITY	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

This course provides a detailed understanding of the concepts of Virtual Reality and its application.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Learn Geometric modeling and Virtual environment
2	To Learn Virtual Hardware and Software
3	To Learn Virtual Reality applications

COURSE OUTCOMES

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

CO1: Differentiate between Virtual, Mixed and Augmented Reality platforms.	Understand
CO2: Identify appropriate design methodologies for immersive technology development, especially from a physiological perspective.	Apply
CO3: Demonstrate foundational literacy in designing gaming systems	Apply
CO4: Categorize the benefits/shortcomings of available immersive technology platforms.	Analyze
CO5: To apply the VR concepts to various applications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	-	-	-	-	-	-	M	M	M	M
CO2	S	M	L	L	M	-	-	-	-	-	-	L	M	M	M
CO3	S	M	L	-	M	-	-	-	-	-	-	M	M	M	M
CO4	S	L	L	L	M	-	-	-	-	-	-	M	M	M	M
CO5	S	M	L	-	M	-	-	-	-	-	-	L	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality**- 3D Computer Graphics** : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modelling – Illumination models – Reflection models – Shading algorithms

GEOMETRIC MODELLING

Geometric Modelling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation **- Geometrical Transformations**: Introduction – Frames of reference – Modelling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection **- A Generic VR system**: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR System

CONTENT CREATION AND INTERACTION ISSUES

Gestalt perceptual organization - real world content - field of view - paradigm shift from real environment to virtual environment - reusing existing content - transition to VR content Human factors : Direct Vs Indirect Interaction - Modes and flow - Input device characteristics - viewpoint and control patterns.

DESIGN ISSUES

Optimizing performance - optimizing target hardware and software **- VR Hardware** : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems**-VR Software**: Introduction – Modelling virtual world –Physical simulation- VR toolkits - multiplayer environment - multiplayer networking architecture.

APPLICATION

Engineering – Entertainment – Science – Training – classroom.

TEXT BOOKS

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2002
2. Jason Jerald, "The VR book: Human centered design for virtual reality", CRC Press, 2015

REFERENCES

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology” , WileyInterscience,1 Edition,1994.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 1st Edition,2002.
4. Jonathan Linowes, "Unity Virtual Reality Projects- Explore the world of virtual reality by building immersive and fun VR Projects using Unity 3D", Packt Publishing, 2015.

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17CSEC33	VIRTUALIZATION TECHNIQUES	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

This syllabus is intended for the Engineering students and enable them to understand the basics virtualization and virtual machines.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the concepts of virtualization and virtual machines
2	To understand the implementation of process and system virtual machines
3	To explore the aspects of high level language virtual machines
4	To gain expertise in server, network and storage virtualization
5	To understand and deploy practical virtualization solutions and enterprise solutions

COURSE OUTCOMES

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

CO1: Install and configure virtualization technology such as VMware	Apply
CO2: Configure and manage virtual network and storage such as vCenter server or ESxi	Apply
CO3: Deploy, manage and migrate virtual machines.	Apply
CO4: Describe the architecture of a Data Center environment with RAID and Intelligent Storage Systems.	Apply
CO5: Configure and manage a Storage Area Network (SAN).	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	-	-	-	-	-	-	-	-	M	M	M	M
CO2	S	M	L	-	M	-	-	-	-	-	-	L	M	S	M
CO3	S	S	M	-	-	-	-	-	-	-	-	M	M	S	M
CO4	S	S	L	-	-	-	-	-	-	-	-		M	M	M
CO5	S	M	L	-	L	-	-	-	-	-	-	L	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF VIRTUALIZATION

System architectures - Virtual Machine basics - Process vs System Virtual Machines - Taxonomy. Emulation: Basic Interpretation - Threaded Interpretation - Precoded and Direct Threaded Interpretation - Binary Translation. System Virtual Machines - Key concepts - Resource utilization basics.

PROCESS VIRTUAL MACHINES

Implementation – Compatibility – Levels – Framework – State Mapping – Register – Memory Address Space – Memory Architecture Emulation – Memory Protection – Instruction Emulation – Performance Tradeoff - Staged Emulation – Exception Emulation – Exception Detection – Interrupt Handling – Operating Systems Emulation – Same OS Emulation – Different OS Emulation – System Environment

HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION

HLL virtual machines: Pascal P-Code – Object Oriented HLLVMs - Java VM architecture - Java Native Interface - Common Language Infrastructure. Server virtualization: Partitioning techniques - virtual hardware - uses of virtual servers - server virtualization platforms.

NETWORK AND STORAGE VIRTUALIZATION

Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization - Routing Protocols. Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level.

APPLYING VIRTUALIZATION

Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers – Socket Programming – UDP Datagram – Introduction to Java Beans.

TEXT BOOKS

1.Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Eighth Edition, Sun Microsystems Press, 2008.

REFERENCES

1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.
3. Kumar Reddy, Victor Moreno, “Network virtualization”, Cisco Press, July, 2006.
4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress 2005.
5. Kenneth Hess , Amy Newman, “Practical Virtualization Solutions: Virtualization from the Trenches”, Prentice Hall, 2010.

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17CSEC34	WEB DESIGN AND MANAGEMENT	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

To understand and learn the scripting languages with design of web applications. and maintenance and evaluation of web design management.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To introduce the student to the tools and facilities of web design
2	To understand and learn the scripting languages with design of web applications
3	To learn the maintenance and evaluation of Web design/development process, with Macromedia Dreamweaver as the primary Web development tool
4	Topics covered include basic and enhanced site structure, local and remote site management, and optimization of Web graphics

COURSE OUTCOMES

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

CO1: Apply an Information Architecture document for a web site.	Apply
CO2: Construct a web site that conforms to the web standards of today and includes e-commerce and web marketing	Analyze
CO3: Perform regular web site maintenance (test, repair and change).	Analyze
CO4: Understand the principles of various process of Project management	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	-	M	-	-	-	-	-	-	-	M	M	M
CO2	S	M	M	-	L	-	-	-	-	-	S	M	M	S	M
CO3	S	M	M	-	M	-	-	-	-	-	M	M	M	S	M
CO4	S	M	S	-	M	-	-	M	-	-	S	M	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

SITE ORGANIZATION AND NAVIGATION

User Centered Design–Web Medium–Web Design Process–Basics of Web Design –Introduction to Software used for Web Design – ADOBE IMAGE READY, DREAM WEAVER, FLASH – Evaluating Process – Site Types and Architectures – Navigation Theory – Basic Navigation Practices – Search – Sitemaps.

ELEMENTS OF PAGEDESIGN

Browser Compatible Design Issues-Pages and Layout – Templates – Text – Color – Images – Graphics and Multimedia – GUI Widgets and Forms – Web Design Patterns – STATIC pages: Slice– URL in ADOBE IMAGE READY. Creation and Editing of site map – Layer, Tables, Frame set, **-** CSS style – Forms –Tools like Insert, Rollover etc., in DREAM WEAVER

SCRIPTING LANGUAGES AND ANIMATION USING FLASH

Client side scripting :XHTML – DHTML – JavaScript – XML Server Side Scripting: Perl–PHP– ASP/JSP Designing a Simple Web Application **-** Introduction to MACROMEDIA FLASH, Importing Other File Formats to Flash – Saving and Exporting Flash Files, Frame by Frame Animation–Motion Tweening – Shape Tweening.

PRE-PRODUCTION MANAGEMENT

Principles of Project Management – Web Project Method – Project Road Map – Project Clarification – Solution Definition – Project Specification – Content – Writing and Managing Content.

PRODUCTION, MAINTENANCE AND EVALUATION

Design and Construction – Testing, Launch and Handover – Maintenance – Review and Evaluation – **Case Study:** Using the Skills and Concepts Learn with the ADOBE IMAGE READY, DREAM WEAVER, FLASH, and Scripts, Develop Portfolios in the Form of Web Pages which have to be uploaded in Free Public Domain.

TEXT BOOKS

1.Themas A. Powell, ―The Complete Reference–Web Design‖, Tata McGraw Hill, Third Edition, 2003.
2.Ashley Friedlein, ―Web Project Management‖, Morgan Kaufmann Publishers, 2001.
3.H.M. Deitel, P.J. Deitel, A.B. Goldberg, ―Internet and World Wide Web – How to Program‖, Third Edition, Pearson Education, 2004.

REFERENCES

1.Joel Sklar, ―Principles of Web Design‖, Thomson Learning, 2001.
2.Van Duyne, Landay and Hong, ―The Design of Sites: Patterns for Creating Winning Websites‖, Second Edition, Prentice Hall, 2006.
3.Lynch, Horton and Rosenfeld, ―Web Style Guide: Basic Design Principles for Creating Websites‖, Second Edition, Yale University Press, 2002.

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17CSEC06	CRYPTOGRAPHY AND NETWORK SECURITY	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

To understand the concepts in cryptography and network security and their applications in real time

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the basic concepts in understanding cryptography and network security
2	To know about various encryption techniques.
3	To understand the concept of Public key cryptography.
4	To study about message authentication and hash functions
5	To impart knowledge on Network security

COURSE OUTCOMES

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

CO1: Classify the symmetric encryption techniques	Understand
CO2: Illustrate various Public key cryptographic techniques	Apply
CO3: Evaluate the authentication and hash algorithms.	Apply
CO4: Discuss authentication applications	Apply
CO5: Summarize the intrusion detection and its solutions to overcome the attacks.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	-	-	-	-	-	-	M	M	-	-
CO2	S	M	L	-	M	-	-	-	-	-	-	M	M	-	-
CO3	S	M	L	-	M	-	-	-	-	-	-	M	M	-	-
CO4	S	M	L	-	M	-	-	-	-	-	-	M	M	M	M
CO5	S	L	L	-	M	-	-	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Security trends – Attacks and services – Classical crypto systems – Different types of ciphers – LFSR sequences – Basic Number theory – Congruences – Chinese Remainder theorem – Modular exponentiation – Fermat and Euler's theorem – Legendre and Jacobi symbols – Finite fields – continued fractions.

METHODS

Simple DES – Differential cryptanalysis – DES – Modes of operation – Triple DES –AES – RC4 – RSA – Attacks – Primality test – factoring

TECHNIQUES

Discrete Logarithms – Computing discrete logs – Diffie-Hellman key exchange –ElGamal Public key cryptosystems – Hash functions – Secure Hash – Birthday attacks -MD5 – Digital signatures – RSA – ElGamal – DSA.

AUTHENTICATION

Authentication applications – Kerberos, X.509, PKI – Electronic Mail security – PGP,S/MIME – IP security – Web Security – SSL, TLS, SET.

SECURITY AND FIREWALLS

System security – Intruders – Malicious software – viruses – Firewalls – Security Standards

TEXT BOOKS

1. Dr. S. Bose and Dr.P. Vijayakumar, “Cryptography and Network Security”, First Edition, Pearson Education, 2016.
2. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd ed, Pearson, 2007.
3. William Stallings, “Cryptography and Network Security Principles and Practices”, Pearson/PHI, 6th edition, 2013.

REFERENCES

1. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing Third Edition –Prentice Hall of India, 2006.

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17BTEC03	PRINCIPLES OF BIOINFORMATICS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Principles of Bioinformatics is an interdisciplinary field that combines Computer Science, Molecular Biology, Genetics ,Mathematics, Statistics and Engineering etc. to analyze and interpret biological data. Bioinformatics has been used for *in silico* analyses of biological queries using mathematical and statistical techniques. This course includes the use computer programming as part of their methodology, in the field of genomics, the identification of candidate genes, genetic basis of disease etc. leading to specific drug discovery by molecular modelling.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Define the basis of Bioinformatics in the biological field
2	Explains the *in-silico* analysis of biological queries using mathematical and statistical techniques.
3	Implement the Bioinformatics software and tools based on its applications
4	Construct the phylogenetic tree based on the biological information and queries using bioinformatics tools.
5	Develop bioinformatics tools in various field like medicine, agriculture etc.,

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Relate the basics of computer science and interdisciplinary subjects related to Bioinformatics	Understand
CO2.Demonstrate the importance of biological databases and their significance in Biotechnology	Understand
CO3. Construct various tools and software which can be adopted in different fields of Biotechnology	Apply
CO4. Build the evolutionary traits using Bioinformatics tools and software	Apply
CO5. Apply the various bioinformatics tools in different fields	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	L	L	-	-	-	-	-	-	L	M	M	-
CO2	L	L	-	-	L	-	L	-	L	M	-	-	-	-	-
CO3	S	S	M	M	M	M	-	-	M	-	-	L	M	-	-
CO4	S	M	S	S	L	M	L	-	M	-	L	L	-	-	-
CO5	S	M	M	S	L	S	L	L	L	S	L	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOINFORMATICS

Introduction, Scope of bioinformatics – Introduction to UNIX- Files and processes, Basic UNIX commands for listing files and directories, Making directories, Changing to a different directory, Copying and moving files, Removing files in directories, Clear, CAT and Less commands, Word count, Help, Redirection, Access rights, Running background process and killing processes, ftp, telnet, Internet, http, Search engines.

DATABASES

Introduction to databases – Flat files, Relational databases, Object oriented databases and hypertext databases, Biological databases and their uses, Introduction to EMB net and NCBI, Classification of biological databases; Primary nucleic acid sequence databases – Gen Bank, EMBL, DDBJ; Primary protein sequence databases – PIR, SWISS-PROT; Composite databases – NRDB, OWL, SWISS-PROT+TrEMBL; Secondary databases – PROSITE, PRINTS; Structural databases – PDB, MMDB.

SEQUENCE ALIGNMENT

Introduction to sequence alignment and its significance, Types – Global, Local, Pairwise and Multiple alignment. DOT PLOTS, Scoring matrices – PAM, BLOSSUM. Dynamic programming algorithms, BLAST, FASTA. Multiple sequence alignment by PSI- BLAST.

PHYLOGENETIC ANALYSIS

Terminology and basics of Phylogenetics – Clades, Taxons, Baranches, Nodes; Orthologs and Paralogs. Steps to construct a Phylogenetic tree – Constructing a Multiple Sequence Alignment, Determining the substitution model, Tree building and tree evaluation.

APPLICATION OF BIOINFORMATICS

Application of bioinformatics in various fields – Medicine, Agriculture and Industries.

TEXT BOOKS:

1. Rastogi, S.C., Namita Mendiratta, Parag Rastogi. 2006. Bioinformatics – Concepts, Skills, Application. CBS Publications.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., 2000. Instant Notes in Bioinformatics. *BIOS Scientific Publishers*.
3. Teresa, K., Attwood and David J. Parry-Smith, 2007. Introduction to Bioinformatics. *Pearson Education Ltd*.

REFERENCES:

1. Bergeran, B., 2002. Bioinformatics Computing. *PHI*.
2. Richard Durbin, Sean Eddy, Anders Krogh and Graeme Mitchison, 1998. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. *Cambridge University Press*.
3. Bishop, M.J., Rawlings, C.J., 1997. DNA and Protein Sequence Analysis. A Practical Approach. *IRL Press*, Oxford.
4. Gibas, C. and Jambeck, P., 1999. Developing Bioinformatics Skills. *O'Reilly*.
5. Dan Gusfield, 2007. Algorithms on Strings Tree and Sequence. *Cambridge University Press*.
6. Baldi, P. and Brunak, S., 1998. Bioinformatics: A Machine Learning Approach. *MIT Press*
7. Essential Bioinformatics. Jin Xiong. Cambridge University Press. 2006.
8. An Introduction ti Bioinformatics Algorithms. Neil C Jones, Pavel A Pevzner. MIT Press.2004.
9. The New Avenue in Bioinformatics. Joseph Seckbeck Eitan Rubin. Springer.2010.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Devika	Professor	Biotechnology	devika@avit.com
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in

17BTCC08	BIOINSTRUMENTATION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Bioinstrumentation course includes the principle, instrumentation and applications of the analytical instruments applied in various fields in biotechnology industry. Students also gain knowledge about the methods to analyze Biomolecules. The course acts as a link between academics and industry.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To discuss about various instruments used in biotechnology.
2	To describe in detail about the Molecular spectroscopy
3	To summarize about different separation and purification techniques used in DNA and protein purification.
4	To distinguish the protein structure using thermal an X- ray based methods.
5	To perform various immunological techniques to identify biomolecules and to analyze different bioprocess techniques

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Outline the basic principles and instruments in biotechnology.	Understand
CO2. Explain about spectroscopy and its principles along with instrumentation.	Understand
CO3. Demonstrate separation and purification techniques in biotechnology.	Apply
CO4. Identify the biomolecular structure by thermal and X- ray based analysis.	Apply
CO5. Analyzebiomolecules by immunological techniques	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	L	L	L	-	M	-	L	M	S	S
CO2	L	M	L	L	-	L	-	-	-	L	-	-	M	S	-
CO3	M	S	M	M	-	L	M	L	L	-	-	L	S	M	S
CO4	M	S	L	S	M	M	-	-	-	-	-	M	S	-	-
CO5	M	M	M	M	M	M	S	S	S	-	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIOINSTRUMENTION

Classification and calibration of instrumental methods, Principles and Instrumentation of pH meter & Electronic balance, Gel documentation system, Turbidimetric and Nephelometric titrations.

SPECTROSCOPY

General design and components of spectroscopy, Principles, Instrumentation and applications of colorimetry, UV – Visible – IR- Raman spectroscopy –NMR spectroscopy, Auger electron and Atomic absorption spectroscopy (AAS)

SEPARATION AND PURIFICATION TECHNIQUES

Principles and Instrumentation of centrifugation, Paper and column chromatography, Ion exchange, Size exclusion, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas chromatography, Electrophoresis of Nucleic acid and protein.

THERMAL AND X-RAY

Thermo-gravimetric methods, Differential thermal analysis, Differential scanning calorimetry. X-ray sources, absorption of X-rays, X-ray diffraction, X-ray detectors.

IMMUNOTECHNIQUES AND ANALYSIS OF BIOPROCESS

Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Immunoblotting, Measurement of BOD and COD in waste waters, Gas analysis for O2 and CO2, Flow injection analysis.

TEXT BOOKS:

1. Chatwal and Anand, 2016. Instrumental Methods of Chemical Analysis, Himalaya Publishing House,5th Edition

2. Upadhyay, Upadhyay and Nath.,2017. Himalaya Publishing House. Biophysical Chemistry (Principles & Technology,4th Edition.

3. Skoog, D., 2014. Instrumental Methods of Analysis, David Hariss, 6th Edition.

4. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods of Analysis. CBS Publishers and Distributors.

REFERENCES:

1. Dinesh Kumar Chatanta and Prahlad Singh Mehra, 2012. Instrumental Methods of Analysis in Biotechnology. I K International Publishing House.
2. P.Asokan. 2003. Analytical Biochemistry. 2nd Edition. China publications.
3. Hobart H. Willard, Lynne L. Merrit, John, A. and Frank A. Settle, 1981. Instrumental Methods of Analysis. Van Nostrand.
4. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, Benjamin Cummins and Company.
5. Sewell, P.A. and Clarke, B., 1991. Chromatographic Separations. John Wiley and Sons.
6. Ewing, G.W., 1989. Instrumental Methods of Chemical Analysis. McGraw Hill Book Company.

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.Nirmala	Assistant professor	Biotechnology	nirmalabt@avit.ac.in
2	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC19	CLINICALTRIALS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Clinical Trial is to expose the students to literature survey and to understand research objectives, learn the advanced instrumental techniques to be used in research, and computational application in Pharmaceutical and Medicinal Chemistry research. The students should also be made aware of the research ethics, principles and conduct of clinical trials for medical research and Intellectual Property Right.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To recognize the research objectives
2	To discuss with the essential components necessary to conduct clinical trial research
3	To Demonstrate the basic principles for design of clinical trials
4	To Execute toxicological studies
5	To Check the interventions

COURSE OUTCOMES

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

CO1. Review the research work.	Understand
CO2. Select the research component	Understand
CO3. Prepare the procedures for clinical trial	Apply
CO4. Appraise the role of toxicology in drug development	Analyze
CO5. Organize a Clinical trial	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	L	-	L	-	L	L	L	L	L	-	-	-
CO2	M	M	L	-	L	L	-	L	-	-	L	L	-	-	-
CO3	S	S	S	S	S	M	M	M	M	-	M	L	S	M	S
CO4	M	M	S	M	-	-	S	M	S	M	M	M	-	M	S
CO5	M	S	S	S	M	M	S	M	S	L	M	M	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

PURPOSE OF RESEARCH

Research –Meaning, Purpose,Types, (Educational, Clinical, Experimental, Historical Descriptive, Basic applied and Patent oriented research), Objectives of research, Literature survey –Use of Library, Books and Journals–Medlines–Internet, Patent Search and Reprints of articles as a source for Literature survey, Selecting a problem and preparing research proposals.

BASIC TERMINOLOGY USED IN CLINICAL RESEARCH

Research –Meaning, Purpose, Types,(Educational, Clinical, Experimental, Historical Descriptive, Basic applied and Patent oriented research), Objectives of research, Literature survey –Use of Library, Books and Journals–Medlines–Internet, Patent Search and Reprints of articles as a source for Literature survey, Selecting aproblem and preparing research proposals.

CLINICAL TRIALS

New drug discovery process – Purpose, Main steps involved in new drug discovery process, Timelines of each steps, Advantages and purposes of each steps, Ethics in clinical research, Unethical trials, Thalidomide tragedy, Phase – I, II, III, IV trials (Introduction and designing, Various phases of clinical trials, Post marketing surveillance, Methods, Principles of sampling, Inclusion and exclusion criteria, Methods of allocation and randomization, Informed consent process in brief, Monitoring treatment outcome, Termination of trial, Safety monitoring in clinical trials).

PRECLINICAL TOXICOLOGY

General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, Animal toxicity requirements.

APPLICATIONS

Study of various clinical trials (completed or ongoing), Clinical trial applications in India Import and export of drug in India, Investigational New Drug application (IND), Abbreviated New Drug Application (ANDA), New Drug Application (NDA).

TEXTBOOKS

1. Katzung, B. G. Basic and Clinical Pharmacology. *Prentice Hall International*.
2. Laurence, D. R. And Bennet, P. N. Clinical Pharmacology. *Scientific Book Agency*.
3. Krishna, D. R. And Klotz, V. Clinical Pharmacokinetics. *Springer Verlab*.
4. Lippincott, Williams and Wilkins. Remington Pharmaceutical Sciences.
5. Kven Stockley and Hamsten. Drug interaction.

REFERENCES:

1. Ethical Guidelines for Biomedical Research on Human Subjects. *Indian Council of Medical Research*, New Delhi, 2000.
2. Rick, N.G., 2004. Drug from Discovery to Approval. *John Wiley & Sons Inc.*.
3. Mehra, J. K. Drug interaction. *Basic Bussiness Publication.*
4. Grahame smith and Aronson. Clinical Pharmacology and Drug Therapy.
5. Richard A. Helms. Text Book of Therapeutics Drug and Disease Management. Hardbound.
6. Herfindal, E. T., Hirschman, J. L., Williams and Wilkins. Clinical Pharmacy and Therapeut

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
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17BTEC23	NANOBIOTECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

One of major applications of nanoscience is in biotechnology field. In various disciplines, a single course which starts by sensitizing students from a varied background about the biological/biotechnological basics and culminates into modern day applications of nanoscience in biotechnology field will be highly useful. This course will act as a bridge between students from non-biology course at all levels

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define about the basic concepts of Nanotechnology.
2	To explain about the Fabrication and Characterization of nanomaterials
3	To classify the nanoscale elements delivery in Biosystems
4	To outline the interaction of Microorganism in Nanobiotechnology.
5	To design the novel drug delivery system for *in vivo* studies

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Explain the terms and properties of nanoparticles	Understand
CO2. Interpret and characterise the nanoparticles	Understand
CO3. Identify the properties of nanoparticle in signalling pathway	Apply
CO4. Examine the role of microorganisms in Nanobiotechnology	Analyse
CO5. Correlate the role of Nano particles in treatment of disease	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	L	-	-	-	-	-	-	L	-	-	M	M	-
CO2	L	L	M	L	-	-	L	-	L	L	L	-	-	M	-
CO3	S	S	M	S	M	-	-	-	-	-	M	L	-	M	-
CO4	M	M	M	M	M	-	S	-	M	S	M	M	-	-	-
CO5	M	M	M	M	M	M	S	L	M	S	M	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO NANOBIOTECHNOLOGY

Introduction to types and properties of nanoparticles, Overview of nanodevices and techniques, Inorganic nano scale systems for biosystems–Nanostructured materials–Fullerenes: Properties and characterization – Carbon nanotubes: Characterisation and application–Quantum dots and wires–Gold Nanoparticles –Nanopores

FABRICATION AND CHARACTERISATION

Synthesis –Top-down and Bottom-up Methods, Epitaxial growth, Characterization: X-Ray Diffraction(XRD), Transmission Electron Microscopy(TEM), Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM), Energy Dispersive of X ray spectrum (EDS)

NANOMOLECULES IN BIOSYSTEMS

DNA, RNA, Proteins and Lipids–Nanoscale elements for delivery of materials into cells, Nanotechnology in cell –Cell motility: Nanomotors and cellular navigation– Chemotaxis –Transmembrane signallingand related proteins.

MICROORGANISMS AND NANOBIOTECHNOLOGY

Nanobiotechnology and microorganisms – Polyhydroxy alkanotes (PHA) Cyanophycin inclusions– Magnetosomes– Alginates s-layer proteins –Bacteriorhodopsin.

APPLICATIONS OF NANOBIOTECHNOLOGY

Nanomedicine, Nanobiosensor–Electrochemical DNA sensors, Nanobiochips, Nanocrystals in Biological Detection, Small scale systems for *in vivo* drug delivery, Nanotechnology for diagnosis and treatment (Cancer and Leprosy), Commercializing Nanobiotechnology. Nanotechnology for disaster relief – Decontamination Emergency equipment, Lab on a chip and sustainability.

TEXT BOOKS:

1. BhushanBharat (Ed.). Hand book of Nanotechnology. *Springer* 3rd Edition (2010)
2. Ajayan P.A. and Schadler L, Braun P. V., Nanocomposite Science and Technology. *Wiley– VCH* (2003).
3. Nlemeyer, C.M. (Ed.) andMirkin, C.A. (Ed.) Nanobiotechnology–Concepts, Applications and Perspectives. *Wiley–VCH* (2004)
4. GeoffOzin and Arsenault, A., Nanochemistry: A Chemical Approach to Nanomaterials. 1st Edn., *Royal Society of Chemistry* (2005)
5. Charles P. Poole and Junior Frank J. Owens, Introduction to Nanotechnology. *John Wiley and Sons* (2003).

REFERENCES:

1. Rosenthal, S.J. and Wright, D.W. Nanobiotechnology Protocols in methods in Molecular Biology Series. *Humana Press* (2005).
2. Michael Crichton. Understanding Nanotechnology. *Scientific American Publisher* (2002).
3. RalphS.Greco,FritzB.Prinz and LaneSmithm,R., Nanoscale Technology in Biological systems. *CRC Press* (2005).

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Deepapriya	Assistant professor	Biotechnology	deepapriya.biotech@avit.ac.in
2	Ms.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC29	GREEN BUILDING AND SUSTAINABLE ENVIRONMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Before starting with this course, one must get a clear knowledge on the basics of green building, learning the plan details of HVAC for a building, energy efficient modelling.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define, develop and & Plan the details of Implementation.
2	To summarize the fundamentals of electric power systems and building electric wiring.
3	To demonstrate about the Bioclimatic design and concepts.
4	To construct the water conservation & water management systems.
5	To assess the key components of remodelling project.

COURSE OUTCOMES

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

CO1. Interpret the basics of green building	Understand
CO2. Explain the advantages and benefits of green building practices	Understand
CO3. Construct low energy architecture features in residential and commercial buildings	Apply
CO4. Develop proper water conservation systems to make up a healthy building	Apply
CO5. Analyse the green sustainable materials and practices	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	M
CO3	M	M	-		L	-	-	-	-	-	-	S	-	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	-	-	-
CO5	M	M	L	L	S	S	-	L	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

GREEN BUILDING BASICS AND PRACTICES:

Site Design / Development & Plan Implementation, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality and Homeowner Education, Operation, Maintenance & Practices. Assessment of building design and construction, emission of CO_2, SO_2, and NO_2 of building materials, elements, and construction process.

ENERGY MANAGEMENT SYSTEM OF BUILDINGS

The objective of the course is to provide students the necessary tools to control, monitor and optimize the building's facilities, mechanical and electrical equipment for comfort, safety, and efficiency. It starts with the fundamentals of electric power systems and building electric wiring and then works through building automation systems (BAS) principles. The course allows students to acquaint applying BAS to commercial HVAC equipment, lighting systems, fire systems and security/observation systems.

LOW ENERGY ARCHITECTURE, PASSIVE BUILDING DESIGN

Solar geometry, climate/regional limitations, natural lighting, passive design and sustainability initiatives, insulating and energy storing material. Bioclimatic design and concepts. Case studies will be used extensively as a vehicle to discuss the success/failure of ideas and their physical applications.

WATER MANAGEMENT, BUILDING METHODS & MATERIALS

Water conservation, water management systems, water efficient landscaping, green roofing, rainwater harvesting, sanitary fixtures and plumbing systems, wastewater treatment and reuse, and process water strategies. AAC (Aerated Autoclave Concrete), ICF (Insulated Concrete Forms), new Advanced Framing & Insulation Techniques, SIPs (Structural Insulated Panels), Straw Bale and Pumice-crete Rammed Earth, Timber Frame, Straw Clay, and Earth ship buildings.

ENERGY EFFICIENT REMODELLING

Key components of remodelling projects-windows, walls, roofs, heating and ventilation, insulation, tighten up the building envelope, Advances in building technology and materials, incorporate active and passive solar into the home or commercial building, Mistakes to avoid, various improvements cost

TEXT BOOKS:

1.Kibert, C. J. "Sustainable Construction: Green Building Design and Delivery," Second Edition, New York:

1. John Wiley & Sons, Inc., 2008.
2. Thermal analysis and design of passive solar buildings by A. K. Athienitis and Mat Santamouris.
3. Passive building desing by N.K. Bansal, G. Hauser, and G. Minke.

REFERENCES:

1. McDonough, W. and Braungart, M. "Cradle to Cradle: Remaking the Way We Make Things," New York: Farrar, Straus and Giroux, 2002

COURSE DESIGNERS

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2	Ms.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.edu.in

17BTEC30	NATURAL RESOURCES MANAGEMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Bioresource management showers the knowledge on importance of various resource available in the world and its economic importance. Students will gain the knowledge in wide spectrum of bioresource availability and its culturing method. This paper also deals with the conservation of wild resource and cultivation of valuable products for the sophistication of human life.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state about the kinds and importance of bioresource management.
2	To describe about the various types of aquaculture and its breeding types.
3	To construct the characteristics of vermiculture and its scope and importance.
4	To categorise and preserve the afforestation process with certain conservation policies.
5	To develop the economic importance of value-added products.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Interpret the basic concepts and importance of Bioresource management	Understand
CO2. Explain the culturing process and various types of aquaculture.	Understand
CO3. Identify the scope and economic importance of vermiculture and sericulture.	Apply
CO4. Categorize the strategies on conservation and management of forest resource.	Analyze
CO5. Analyze the crop improvement technologies in the production of bioresource products.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	L	L	-	-	L	-	-	-	-	M	M	-	M
CO2	L	-	M	L	L	-	M	-	S	-	L	M	-	-	-
CO3	S	S	-	-	-	-	M	L	-	-	L	-	-	-	-
CO4	L	-	L	L	-	L	S	L	-	-	-	-	-	-	-
CO5	L	L	-	L	-	-	L	-	-	-	-	S	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIORESOURCE MANAGEMENT

Basics of Bioresources - Concept, kinds, importance. Human Resource: Management, scope and importance of human resource management (HRM) and personnel management; human development index (HDI). Animal Resources Conservation and Management: Concept on livestock and livestock production management; role in livelihood and nutritional securities; sustainable livestock production, problems and opportunities

AQUACULTURE

Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important of fishes. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control.

VERIMICULTURE AND SERICULTURE

Introduction and scope, Species of earthworm, Characteristics features of earthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer. Overview of scope, economic importance and the product of Sericulture.

FOREST MANAGEMENT AND PLANTS CULTIVATION

Classification and distribution of forests, current strategies of conservation and management of forest resource; agro-forestry, social forestry; Joint Forest Management; National Forest Policy; Forest (conservation) Act, 1980. A brief account of Harlan and Hawkes theories; practices of floriculture, agroforestry, BT crops (brief account).

VALUE ADDED BIORESOURCE PRODUCTS

Economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.

TEXT BOOKS:

1. Manju Yadav. 2010. “Economic Zoology” Discovery publishing housePvt.Ltd., New Delhi
2. Trivedi, T, R. (2011) “Forest Management”Discovery Publishing Pvt.Ltd. New Delhi
3. Milton Fingerman, RachakondaNagabhushanam 2000. “Recent Advances in Marine Biotechnology” IstEdition Science Pub Inc.

REFERENCES:

1. Peter Bettinger Kevin Boston Jacek Siry Donald Grebner 2017. Forest Management and Planning 2nd Edition. Academic press.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.Chozhavendhan. S	Associate professor	Biotechnology	chozhavendhan@avit.ac.in
2	Mrs.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.edu.in

17CVEC07	DISASTER MITIGATION AND MANAGEMENT	Category	L	T	P	Credit
		EC	3	0	0	3

Preamble

This course deals with the various disasters and to expose the students about the measures, its effect against built structures, and Hazard Assessment procedure in India. This course also deals with the methods of mitigating various hazards such that their impact on communities is reduced.

Prerequisite

Nil

Course Objectives

1	To Understand basic concepts in Disaster Management
2	To Understand Definitions and Terminologies used in Disaster Management
3	To Understand the Challenges posed by Disasters
4	To understand Impacts of Disasters

Course Outcomes

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

Co1. Understand the various types of disaster viz Hydrological, Coastal and Marine Disasters, Atmospheric Disasters, Geological, Mass Movement and Land Disasters, Wind and Water Driven Disasters.	Understand
Co2. Identify the potential deficiencies of existing buildings for Earthquake disaster and suggest suitable remedial measures.	Understand
Co3.Derive the guide lines for the precautionary measures and rehabilitation measures for Earthquake disaster.	Apply
Co4. Derive the protection measures against floods, cyclone, land slides	Apply
Co5. Understand the effects of disasters on built structures in India	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2.	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3.	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4.	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5.	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	**INTRODUCTION**	**9 – hours**
Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events (Global, national and regional); Natural and man-made hazards		
UNIT – II	**RISK ASSESSMENT AND VULNERABILITY ANALYSIS**	**9 – hours**
Response time, frequency and forewarning levels of different hazards; Characteristics and damage potential of natural hazards; hazard assessment ;Dimensions of vulnerability factors; vulnerability assessment; Vulnerability and disaster risk; Vulnerabilities to flood and earthquake hazards		
UNIT – III	**DISASTER MANAGEMENT MECHANISM**	**9 – hours**
Concepts of risk management and crisis management ; Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness; Planning for relief		
UNIT – IV	**DISASTER RESPONSE**	**9 – hours**
Mass media and disaster management; Disaster Response Plan; Communication, Participation, and Activation of Emergency Preparedness Plan; Logistics Management; Psychological Response; Trauma and Stress Management; Rumour and Panic Management ;Minimum Standards of Relief; Managing Relief; Funding.		
UNIT – V	**DISASTER MANAGEMENT IN INDIA**	**9 – hours**
Strategies for disaster management planning; Steps for formulating a disaster risk reduction plan; Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans.		

Text Books

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007.

Reference Books

1. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
2. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
3. Goswami, S. C. Remote Sensing Application in North East India, Purbanchal Prakesh, Guwahati, 1997.
4. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
5. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. National Policy on Disaster Management, NDMA, New Delhi, 2009.
7. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.

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17CVEC09	HOUSING PLANNING AND MANAGEMENT	Category	L	T	P	Credit
		EC	3	0	0	3

Preamble

This course work imparts knowledge required for understanding the general principles of building planning and services with the help of relevant codes, manuals and guidelines.

Prerequisite

Nil

Course Objectives

1	An introduction to housing planning
2	Construction and financing of housing projects.
3	The course focuses on cost effective construction materials and methods.
4	Emphasis has also been given on the principles of sustainable housing policies and programmes.

Course Outcomes

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

CO1. Apply the general planning considerations and development control rules for different types of buildings.	Apply
CO2. Apply the principles of electrical and lighting services for different uses in buildings	Apply
CO3. Understand and apply the principles of plumbing services for domestic and industrial needs	Understand
CO4. Plan and design the requirements for HVAC systems, fire fighting and other necessary services for a various types buildings	Apply
CO5. Incorporate the integrated planning and designing of necessary building services for better usage of buildings	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1.	**S**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**L**
CO2.	**S**	**S**	**S**	**M**	**M**	**M**	**M**	**-**	**-**	**L**	**-**	**M**	**-**	**-**	**-**
CO3.	**S**	**S**	**S**	**M**	**M**	**-**	**L**	**-**	**-**	**-**	**-**	**L**	**-**	**-**	**-**
CO4.	**S**	**S**	**S**	**M**	**M**	**L**	**L**	**-**	**-**	**-**	**-**	**L**	**L**	**-**	**M**
CO5.	**S**	**S**	**S**	**M**	**M**	**L**	**L**	**-**	**-**	**-**	**-**	**L**	**-**	**-**	**-**

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I	**INTRODUCTION TO HOUSING**	**9 - hours**
Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels		
UNIT - II	**HOUSING PROGRAMMES**	**9 - hours**
Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.		
UNIT - III	**PLANNING AND DESIGN OF HOUSING PROJECTS**	**9 - hours**
Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)		
UNIT - IV	**CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS**	**9 - hours**
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation		
UNIT - V	**HOUSING FINANCE AND PROJECT APPRAISAL**	**9 - hours**
Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems)		

Text Books

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 1999.

2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House,Bombay, 1997.

Reference Books

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.

2.Dhir,B.M,Construction Planning And Management , New Age International(P)Limited,Publishers.

3. Lal,A.K,Hand Book Of Low Cost Housing, New Age International(P)Limited,Publishers.

4.Panchdhari,A.C,Water Supply & Sanitary Installations,New Age International(P)Limited,Publishers.

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17CVEC18	WIND ENGINEERING	Category	L	T	P	Credit
		EC	3	0	0	3

Preamble

The course includes studies of sustainable development and energy sources. Basic mathematical and physical concepts will be covered. An introduction to prerequisites for wind power development including how a wind turbine works, planning for wind energy, environmental impact, location and economic aspects will be given. The phases of wind power projects is studied. Oral and written presentations in a scientific context will be discussed and practiced in the course. A site study visit to an operating wind farm is included.

Prerequisite

Nil

Course Objectives

1. To learn about the forces generated on structures due to normal wind as well as gusts.
2. To analyses the dynamic effects produced due to chimney,tower and silos
3. To understand about the seismic design of various structures
4. To analyses the application in design and its implementations

Course Outcomes

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

CO1.Give an account of and analyse energy sources and their sustainability	Understand
Co2. Identify and explain a wind power project's phases	Create
Co3. Identify and evaluate factors affecting wind energy development	apply
Co4. Analyse the siting conditions for wind power development	apply
CO5. Clearly present an individual or group assignment within wind power in oral or written form	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COS	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	PSO 3
CO1.	L	S	S	S	-	L	S	L	-	-	L	-	-	L	L
CO2.	L	S	S	S	L	M	S	L	-	L	L	-	-	-	-
CO3	S	S	S	S	L	M	L	L	-	L	-	-	-	-	-
CO4	L	S	L	S	L	-	S	L	-	L	-	L	-	-	-
CO5	S	S	S	S	-	-	S	M	-	L	L	-	-	-	-

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I	INTRODUCTION	9 - hours
Terminology – Wind Data – Gust factor and its determination - Wind speed variation with height – Shape factor – Aspect ratio – Drag and lift.		
UNIT - II	**EFFECT OF WIND ON STRUCTURES**	**9 - hours**
Static effect – Dynamic effect – Interference effects (concept only) – Rigid structure – Aeroelastic structure (concept only).		
UNIT - III	**EFFECT ON TYPICAL STRUCTURES**	**9 - hours**
Tail buildings – Low rise buildings – Roof and cladding – Chimneys, towers and bridges.		
UNIT - IV	**APPLICATION TO DESIGN**	**9 - hours**
Design forces on multistorey building, towers and roof trusses.		
UNIT - V	**INTRODUCTION TO WIND TUNNEL**	**9 - hours**
Types of models (Principles only) – Basic considerations – Examples of tests and their use.		

Text Books

1. Peter Sachs, “Wind Forces in Engineering, Pergamon Press, New York, 1992.
2. Lawson T.V., Wind Effects on Buildings, Vols. I and II, Applied Science and Publishers, London, 1993.

Reference Books

1. Devenport A.G., “Wind Loads on Structures”, Division of Building Research, Ottowa, 1990.
2. Wind Force on Structures – Course Notes, Building Technology Centre, Anna University, 1995

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17MECC03	ENGINEERING MECHANICS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble
This course provides the basic knowledge about the behaviour of the bodies which are under static and dynamic conditions.

Prerequisite
NIL

Course Objective

1	To explain the basic laws of mechanics and forces
2	To relate the basic concepts and application of rigid bodies under equilibrium in two dimension
3	To solve the problems related to properties of surfaces and solids
4	To solve problems involving Friction and Rigid body dynamics.
5	To analyze the dynamics of particles problems.

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

CO1.	Identify the engineering problems using the concept of static equilibrium	Understand
CO2.	Solve problems of rigid bodies under equilibrium in two dimension	Apply
CO3.	Determine the Centroid, moment of inertia and mass moment of inertia of various sections.	Apply
CO4.	Solve frictional and rigid body application problems.	Apply
CO5.	Analyze engineering systems using the concept of dynamic equilibrium	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	L	-	-	-	-	-	-	L	-	
CO2	S	s	M	M	-	M	-	-	-	-	-	-	L	-	
CO3	S	M	M	M	-	M	-	-	-	-	-	-	L	-	
CO4	S	S	M	M	-	L	-	-	-	-	-	-	L	-	
CO5	S	S	L	S	-	S	-	-	-	-	-	-	L	-	

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS & STATICS OF PARTICLES

Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem. Parallelogram and triangular law of forces - Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - Single equivalent force.

EQUILIBRIUM OF RIGID BODIES

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimension.

PROPERTIES OF SURFACES AND SOLIDS

Determination of Areas and Volumes - First moment of area - centroid of sections - Rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula - second and product moments of plane area - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Principle moments of inertia of plane areas - Mass moment of inertia.

FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

Frictional force - Laws of Coloumb friction - simple contact friction - Rolling resistance - Belt friction. Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion.

DYNAMICS OF PARTICLES

Displacement, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's law - Work Energy equation of particles - Impulse and Momentum - Impact of elastic bodies.

Text Books

1	Beer & Johnson, Vector Mechanics for Engineers. Vol. I Statics and Vol. II Dynamics, McGraw Hill International Edition, 1995.
2	Kottiswaran N, Engineering Mechanics-Statics & Dynamics, Sri Balaji Publications,2014.
3	Meriam, Engineering Mechanics, Vol. I Statics & Vol. II Dynamics 2/e, Wiley Intl., 1998.

Reference Books

1	Rajasekaran.S, and Sankara Subramanian G, “Engineering Mechanics”, Vikas Publishing Co. New Delhi.
2	Irving H. Shames and G.Krishna Mohana Rao, Engineering Mechanics - Statics & Dynamics, 4th Edition, Prentice Hall of India Pvt. Ltd., 1997.
3	K.L.Kumar, Engineering Mechanics III Edition, Tata McGraw Hill Publishing Co. Ltd., 1998

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17MBHS04	TOTAL QUALITY MANAGEMENT	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE:

Quality is the mantra for success or even for the survival of any organization in this competitive global market. Total Quality Management (TQM) is an enhancement to the traditional way of doing business. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach for providing quality of products and processes. It becomes essential to survive and grow in global markets, organizations will be required to develop customer focus and involve employees to continually improve Quality and keep sustainable growth.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Total Quality Management concepts.
2. To practice the TQM principles.
3. To apply the statistical process control
4. To analyze the various TQM tools
5. To adopt the quality systems.

COURSE OUTCOMES:

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

CO1: Understand the importance of quality and TQM at managerial level.	Understand
CO2: Practice the relevant quality improvement tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Assess various TQM Techniques.	Evaluate
CO5: Practice the Quality Management Systems in a different organization Environment.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	-	L	L	L	M	L	M	L	M	L
CO2	M	-	-	-	L	L	-	L	M	M	-	L	M	L	-
CO3	S	S	M	S	S	-	-	L	-	L	-	L	M	M	-
CO4	L	M	S	L	M	-	L	-	L	M	L	M	M	-	L
CO5	L	L	M	-	L	M	S	S	M	L	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

Quality: Definition - Dimensions - Planning- costs – Analysis Techniques for Quality Costs- Basic concepts of Total Quality Management- Historical Review- Principles - Leadership – Concepts- Role of Top Management- Quality Council – Quality Statements- Strategic Planning- Deming Philosophy- TQM Implementation – Barriers.

TQM PRINCIPLES

Customer satisfaction – Perception of Quality- Complaints- Service Quality- Customer Retention- Employee Involvement – Motivation- Empowerment - Teams- Recognition and Reward- Performance Appraisal- Benefits- Continuous Process Improvement – Juran's Trilogy- PDSA Cycle- 5S – Kaizen - Basic Concepts.

STATISTICAL PROCESS CONTROL (SPC)

The Seven tools of Quality- Statistical Fundamentals – Measures of central Tendency & Dispersion- Population and Sample- Normal Curve- Control Charts for variables and attributes- Process capability- Concept of six sigma- New seven Management tools.

TQM TOOLS

Benchmarking – Reasons - Process- Quality Function Deployment (QFD) – House of Quality- QFD Process- Benefits- Taguchi Quality Loss Function- Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA.

QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems- ISO 9000:2000 Quality System – Elements- Implementation of Quality System- Documentation- Quality Auditing- QS 9000- ISO 14000 – Concept- Requirements and Benefits.

TEXT BOOKS:

1. Dale H.Besterfiled- et at. - Total Quality Management- PHI-1999. (Indian reprint 2002).
2. Feigenbaum.A.V. "Total Quality Management- McGraw-Hill- 1991.

REFERENCES:

1. James R.Evans & William M.Lidsay - The Management and Control of Quality- (5th Edition) - South-Western (Thomson Learning) - 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd - Oxford. 1989.
3. Narayana V and Sreenivasan - N.S. Quality Management – Concepts and Tasks- New Age International 1996.

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Course code 17MBHS03	ENGINEERING MANAGEMENT AND ETHICS	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE: Engineering management provides technological problem-solving ability of engineering and the organizational to oversee the operational performance of complex engineering enterprises to Engineers. Engineers require honesty, impartiality, fairness, and equity, and dedication to the protection of the public health, safety, and welfare. Ethics emphasises the importance of moral issues, rights and duties of the employees through basic ethics confronting individuals and organizations engaged. It also emphasise values that are morally desirable in engineering practice and research. It allows them to understand various occupational crimes and learn the moral leadership.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To Understand the principles of planning at various levels of the organisation.
2. To analyse and practice the concepts of organizing, staffing to higher productivity.
3. To apply the concepts related to directing and controlling.
4. To understand and apply the case studies to practice code of ethics in organisation.
5. To apply the ethical principles in working environment.

COURSE OUTCOMES:

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

CO1: Understand the importance of planning principles in organization	Understand
CO2: Apply the various strategies of organising and staffing process.	Apply
CO3: Analyse various leadership skills and control techniques for shaping the organization.	Analyse
CO4: Understand and apply best ethical practices in organisation	Analyse
CO5: Analyse and Apply relevant ethical practices in engineering.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	L	S	M	M	L	S	S	S	S	S	M	M
CO2	M	L	L	-	M	M	M	L	M	S	M	M	M	-	L
CO3	M	M	L	-	M	M	M	L	L	S	S	M	M	-	L
CO4	L	M	-	M	-	M	S	S	S	S	-	M	L	M	M
CO5	M	M	-	L	-	M	S	S	S	S	-	M	L	-	S

S- Strong; M-Medium; L-Low

SYLLABUS:

PLANNING

Management – Nature & Scope – Functions of Management – Levels of Management – Role of Managers - Nature and purpose of planning - Planning process - Types of plans – Objectives Managing by objective (MBO) -

Decision Making - Types of decision - Decision Making Process - Decision Making under different conditions.

ORGANIZING & STAFFING

Nature and purpose of organizing - Organization structure - Formal and informal Organization - Line and Staff authority - Depart mentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training Methods - Performance Appraisal.

DIRECTING & CONTROLLING

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Communication - Barriers to effective Communication – Controlling – Controlling Techniques - Organization Culture - Elements and types of culture – Managing cultural diversity.

INTRODUCTION TO ETHICS

Moral dilemmas -Uses of Ethical Theories- Engineering As Social Experimentation- Engineer's Responsibility For Safety-Codes of Ethics-Challenger Case Study.

ETHICS IN ENGINEERING

Employed Engineers Rights and Duties- Collective Bargaining - Occupational Crime - Global Issues- Multinational Corporation- Technology transfer - Engineers as managers - Consulting Engineers - Expert Witness-Moral Leadership.

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.

2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.

3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).

2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.

3. Andrew J. Dubrin, 'Essentials of Management', Thomson South-western, 7th edition, 2007.

4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)

5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

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Course code: 17MBHS05	Marketing Techniques for Engineers	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE: Marketing is enveloping trend in modern competitive world as it contributes greatly for the productivity of firms. Marketing includes advertising, promotions, public relations, and sales and procedure of introducing and promoting the product or service into the market and enhancing sales from the buying public. Marketing techniques are significant management process that includes the distribution of marketing activities. Marketing techniques for engineers emphasises the ways to Work closely with advertising and **marketing** teams to promote understanding of the product, Gives technical presentations and demonstrations on products and makes the engineers to Participate in product development cycle giving input about clients potential needs.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the concept of marketing.
2. To analyse various indicators of marketing
3. To assess the product Promotion and relevant Strategies.
4. To evaluate market channel for Promotion .
5. To Apply and practice Promotional activities covering online Marketing.

COURSE OUTCOMES:

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

CO1: Understand the basics of marketing opportunities	Understand
CO2: Analyse the relevant marketing engineering strategies	Analyse
CO3: Apply analytical skills in solving Product promotional challenges	Apply
CO4: Assess the marketing distribution strategies	Analyse
CO5: Analyse the digital marketing techniques for both Product and Market Promotion	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	L	-	L	M	M	L	S	-	L	-	-	M
CO2	-	-	-	L	L	L	M	M	M	M	-	M	-	L	L
CO3	L	-	-	L	L	L	-	-	M	M	L	M	-	L	M
CO4	L	-	-	M	L	L	-	-	-	M	M	M	-	M	-
CO5	L	M	M	M	M	M	-	-	M	M	M	M	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS:

Basics of Marketing

Meaning – Definition and Importance of Marketing – Difference between Selling and Marketing – Approaches to the study of Marketing – Marketing concept – Market Segmentation – Basic for segmenting the consumer market – Marketing Environment - macro and micro components and their impact on marketing decisions - Buyer Behaviour.

Marketing Engineering:

Marketing engineering – importance – Marketing environment decision – Marketing Engineering approach- Marketing Engineering opportunities – Re-engineering Marketing –tools for Marketing engineering –Dynamic effects of Marketing engineering.

Product Promotion

Product – Meaning and Definition – Product Policy – Classification of Products – Product mix – product line strategies – Branding– Product life cycle – New Product Development case studies - Pricing – Importance of Price – Objectives of Pricing- Factors affecting Price determination – Pricing Policies – kinds of Pricing – Pricing of New products – Discounts and Allowance- Resale – Price maintenance.

Market Promotion

Channels of Distribution – Factors influencing the choice of a channel – Channel of Distribution for consumer and Industrial goods – Middlemen – Kinds of Wholesalers and retailers and their functions- Promotional mix- Factors determining promotional mix – Sales promotion – Objectives – Types- Advertising Budget – Personal Selling – Kinds of Advertising – Benefits –– Personal selling – kinds of salesmen – Function – Qualities of a good salesmen- process of selling.

Marketing Research and Online Marketing

Marketing Research: Meaning and scope of marketing research; Marketing research process- Social, ethical and legal aspects of marketing; Marketing of services; International marketing; Green marketing; Cyber marketing; Relationship marketing and other developments of marketing. The evolution of online marketing technologies – Difference between online and traditional advertising - Difference between search engines and search advertising – Measuring the effectiveness of online advertising- improving paid search engines.

TEXT BOOK:

1. Philip Kotler, Marketing Management,Millennium Edition, Prentice Hall Publication.
2. KS Chandrasekar, "Marketing management Text and Cases", Tata McGrawHill - Vijaynicole, First edition,2010
3. Gary L. Lilien (Author), Arvind Rangaswamy (Author), De Bruyn, Arnaud (Author) "Principles of Marketing Engineering and Analytics"– April 21, 2017

REFERENCES:

1. Ramasamy &Namakumari, Marketing Management, Macmillan Pub.
2. Arunkumar, Meenakshi, Marketing Management, Vikas Pub.
3. Sherlaker.S.A, Marketing Management, HPH
4. Rajan Saxena, Marketing Management, TMH
5. Beri. C. G, Marketing Research, Sultan Chand Pub.

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