NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi
for
B.E – B.E – Biomedical Engineering [R17]
[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year 2017-2018 onwards)

SEPTEMBER 2021

BME Department PEO'S and PO'S

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1: Advance in their careers in biomedical engineering or related areas of industry, academia and medicine.
PEO2: Engage in life-long learning, by enrolling in graduate or professional degree programs or receiving advanced training for professional advancement.
PEO3: Utilize their engineering experience in creating new knowledge or enabling technologies for improvement of human health and health care.
PEO4: Understand the social and ethical implications of their work.
PEO5: Excel in their careers by being a part of success and growth of an organization with which they are associated.

PROGRAM OUTCOMES:

At the end of a programme a students will be able to demonstrate ability to

a-l	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	Engineering Knowledge	PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b	Problem Analysis	PO2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
c	Design and Development of Solutions	PO3	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
d	Investigation of Complex Problems	PO4	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
e	Modern Tool Usage	PO5	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
f	The Engineer and Society	PO6	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
g	Environment and Sustainability	PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
h	Ethics	PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
i	Individual and	PO9	Function effectively as an individual, and as a member or leader in diverse

	Team Work		teams, and in multidisciplinary settings
j	Communication	PO10	Communication 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
k	Project Management and Finance	PO11	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
l	Lifelong Learning	PO12	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:

PSO1: At the end of the course the student would be able to apply the fundamentals of Biomedical Engineering to solve the problems at the interface of engineering and biology.

PSO2: Students would be able to measure and interpret data develop algorithms to solve healthcare related problems in medical sector.

PSO3: The ability to demonstrate, develop medical devices, materials for the improvement of human health care.

PSO4: Able to do lifelong learning in bioengineering-related fields such as: imaging and sensing, Therapeutics, biomechanics, cell and tissue engineering

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

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

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	2	2	2	1	1	2	1	1	3	1
2	3	3	2	2	2	1	1	1	1	2	3	3
3	3	3	3	3	3	3	2	1	2	3	2	2
4	3	2	3	2	2	2	2	3	1	1	2	2
5	3	3	2	3	2	1	2	3	2	2	3	1

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

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

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
1	3	3	2	3	2	1	1	1	1	1	1	2
2	3	3	3	3	3	2	2	3	1	3	3	3
3	3	3	3	3	3	3	3	2	1	1	1	3
4	3	3	2	3	3	2	2	3	1	2	2	2

Contribution **1: Reasonable** **2: Significant** **3: Strong**

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REGULATIONS – 2017 **CHOICE BASED CREDIT SYSTEM**

B.E. BIOMEDICAL ENGINEERING

CURRICULAM: I – VIII SEMESTERS **SYLLABUS: 1 to 8 SEMESTERS**

SEMESTER: I									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17EYA01	Professional English- I	HS	-	4	2	0	2	3
2.	17MYB01	Calculus and Solid Geometry	BS	-	5	3	2	0	4
3.	17PYB01	Physics for Engineers	BS	-	3	3	0	0	3
4.	17CYB02	Applied Electrochemistry	BS	-	3	3	0	0	3
5.	17CSC02	Python Programming	ES	-	3	3	0	0	3
6.	17ECC01	Electronic Devices	ES	-	3	3	0	0	3
PRACTICAL									
7.	17CSP02	Python Programming Laboratory	ES	-	4	0	0	4	2
8.	17GYP02	Engineering Practices Laboratory	ES	-	4	0	0	4	2
9.	17GEP01	Personal Values	HS	-	2	0	0	2	0
				TOTAL	**31**	**17**	**2**	**12**	**23**

SEMESTER: II									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17EYA02	Professional English – II	HS	17EYA01	4	2	0	2	3
2.	17MYB02	Complex Analysis and Laplace Transforms	BS	17MYB01	5	3	2	0	4
3.	17PYB07	Physics for Biomedical Engineers	BS	17PYB01	3	3	0	0	3
4.	17CYB05	Chemistry for Biomedical Engineers	BS	-	3	3	0	0	3
5.	17MEC01	Engineering Graphics	ES	-	4	2	2	0	3
6.	17ECC03	Circuit Theory	ES	-	3	3	0	0	3
PRACTICAL									
7.	17GYP01	Physics and Chemistry Laboratory	BS	-	4	0	0	4	2
8.	17ECP01	Circuits and Devices Laboratory	ES	17ECC01	4	0	0	4	2
9.	17GEP02	Inter Personal Values	HS	17GEP01	2	0	0	2	0
				TOTAL	**32**	**16**	**4**	**12**	**23**

SEMESTER: III									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17MYB05	Transforms and Partial Differential Equations	BS	17MYB02	4	2	2	0	3
2.	17ECC23	Basics of Electrical Engineering	ES	-	3	3	0	0	3
3.	17MEC23	Engineering Mechanics for Biomedical Engineers	ES	-	3	2	2	0	3
4.	17ITC03	Data Structures and Algorithms	ES	-	4	2	0	2	3
5.	17ECC06	Digital Logic Design	PC	17ECC01	3	3	0	0	3
6.	17BMC01	Anatomy and Human Physiology	PC	17CYB05	3	3	0	0	3
PRACTICAL									
7.	17ECP03	Digital Logic Design Laboratory	PC	17ECP01	4	0	0	4	2
8.	17BMP01	Human Physiology Laboratory	PC	-	4	0	0	2	2
9.	17GED02	Soft Skills-Reading and Writing	EEC	-	2	0	0	2	0
				TOTAL	**30**	**15**	**4**	**10**	**22**

SEMESTER: IV									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17MYB09	Probability and Random Processes	BS	17MYB02	4	2	2	0	3
2.	17ECC07	Signals and Systems	PC	17MYB02	3	3	0	0	3
3.	17ECC11	Analog Circuit Design	PC	17ECC01	3	3	0	0	3
4.	17BMC02	Sensors and Signal Conditioning	PC	-	3	3	0	0	3
5.	17BMC03	Bio Control Systems	PC	-	3	3	0	0	3
6.	17ITC08	Fundamentals of Java Programming	ES	17ITC03	4	2	0	2	3
PRACTICAL									
7.	17ECP06	Analog Circuit Design Laboratory	PC	17ECP01	4	0	0	4	2
8.	17BMP02	Sensors and Signal Conditioning Laboratory	PC	-	2	0	0	4	2
9.	17GED01	Soft Skills-Listening and Speaking	EEC	-	2	0	0	2	0
10.	17GED03	Personality and Character Development	EEC	-	2	0	0	2	0
				TOTAL	**30**	**16**	**2**	**14**	**22**

SEMESTER: V									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17CYB03	Environmental Science	BS	-	3	3	0	0	3
2.	17GEA02	Principles of Management	HS	-	3	3	0	0	3
3.	17ECC16	Analog and Digital Communication	PC	17ECC06	3	3	0	0	3
4.	17BMC04	Biosignal Processing	PC	17ECC07	3	3	0	0	3
5.	17BMC05	Bio Medical Instrumentation-I	PC	17BMC02	3	3	0	0	3
6.	E1	Elective I (PSE)	PSE	-	3	3	0	0	3
PRACTICAL									
7.	17BMP03	Biosignal Processing Laboratory	PC	-	4	0	0	4	2
8.	17BMP04	Biomedical Instrumentation-I Laboratory	PC	17BMP02	4	0	0	4	2
9.	17GED07	Constitution Of India	EEC	-	2	0	0	2	0
				TOTAL	**28**	**18**	**0**	**10**	**22**

SEMESTER: VI									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17ECC13	Microprocessors and Microcontrollers Interfacing	PC	17ECC06	3	3	0	0	3
2.	17BMC06	Medical Image Processing	PC	-	4	2	0	2	3
3.	17BMC07	Biomedical Instrumentation-II	PC	17BMC05	3	3	0	0	3
4.	E2	Elective II (PSE)	PSE	-	3	3	0	0	3
5.	E3	Elective III (PSE)	PSE	-	3	3	0	0	3
6.	E4	Elective IV (PSE/OE)	PSE/OE	-	3	3	0	0	3
PRACTICAL									
7.	17ECP08	Microprocessors and Microcontrollers Interfacing Laboratory	PC	17ECP03	4	0	0	4	2
8.	17BMP05	Biomedical Instrumentation-II Laboratory	PC	17BMP04	4	0	0	4	2
9.	17GED06	Comprehension	EEC	ALL CORE SUBJECT	2	0	0	2	0
10.	17GED08	Essence of Indian Tradition Knowledge	EEC	17GEP01	2	0	0	2	0
				TOTAL	**31**	**17**	**0**	**14**	**22**

SEMESTER: VII									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17BMC08	Medical Imaging Techniques	PC	17BMC04	3	3	0	0	3
2.	17BMC09	Rehabilitation Engineering	PC	-	3	3	0	0	3
3.	E5	Elective – V (PSE)	PSE	-	3	3	0	0	3
4.	E6	Elective – VI (PSE/OE)	PSE/OE	-	3	3	0	0	3
5.	E7	Elective – VII (OE)	OE	-	3	3	0	0	3
PRACTICAL									
6.	17BMP06	Hospital Internship	PC	-	2	0	0	2	1
7.	17BMD01	Project work-I	EEC	-	8	0	0	8	4
				TOTAL	**25**	**15**	**0**	**10**	**20**

SEMESTER: VIII									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	E8	Elective VIII (PSE)	PSE	-	3	3	0	0	3
2.	E9	Elective IX (OE)	OE	-	3	3	0	0	3
PRACTICAL									
3.	17BMD02	Project work-II	EEC	17BMD01	16	0	0	16	8
				TOTAL	**22**	**6**	**0**	**16**	**14**

TOTAL NO. OF CREDITS: 168

B.E. BIOMEDICAL ENGINEERING

REGULATIONS – 2017 **CHOICE BASED CREDIT SYSTEM**

(A) HS,BS, and ES Courses

(a) Humanities and Social Sciences (HS) **AICTE Credit Distribution Norm:12**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P. S
1.	17EYA01	Professional English-I	HS	-	4	2	0	2	3	I
2.	17GEP01	Personal Values	HS	-	2	0	0	2	0	I
3.	17EYA02	Professional English-II	HS	17EYA01	4	2	0	2	3	II
4.	17GEP02	Inter Personal Values	HS	17GEP01	2	0	0	2	0	II
5.	17GEA02	Principles of Management	HS		3	3	0	0	3	V

(b) Basic Sciences (BS) **AICTE Credit Distribution Norm:25**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1.	17MYB01	Calculus and Solid Geometry	BS	-	5	3	2	0	4	I
2.	17PYB01	Physics for Engineers	BS	-	3	3	0	0	3	I
3.	17CYB02	Applied Electrochemistry	BS	-	3	3	0	0	3	I
4.	17MYB02	Complex Analysis and Laplace Transforms	BS	17MYB01	5	3	2	0	4	II
5.	17PYB07	Physics for Biomedical Engineers	BS	17PYB01	3	3	0	0	3	II
6.	17CYB05	Chemistry for Biomedical Engineers	BS	-	3	3	0	0	3	II
7.	17GYP01	Physics and Chemistry Laboratory	BS	-	4	0	0	4	2	II
8.	17MYB05	Transforms and Partial Differential Equations	BS	17MYB02	4	2	2	0	3	III
9.	17MYB09	Probability and Random Processes	BS	17MYB02	4	2	2	0	3	IV
10.	17CYB03	Environmental Science	BS	-	3	3	0	0	3	V

(c) Engineering Sciences (ES)			AICTE Credit Distribution Norm:24							
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	17CSC02	Python Programming	ES	-	3	3	0	0	3	I
2.	17ECC01	Electronic Devices	ES	-	3	3	0	0	3	I
3.	17CSP02	Python Programming Laboratory	ES	-	4	0	0	4	2	I
4.	17GYP02	Engineering Practices Laboratory	ES	-	4	0	0	4	2	I
5.	17MEC01	Engineering Graphics	ES	-	4	2	2	0	3	II
6.	17ECC03	Circuit Theory	ES	-	3	3	0	0	3	II
7.	17ECP01	Circuits and Devices Laboratory	ES	17ECC01	4	0	0	4	2	II
8.	17ECC23	Basics of Electrical Engineering	ES	-	3	3	0	0	3	III
9.	17MEC23	Engineering Mechanics for Biomedical Engineers	ES	-	3	3	0	0	3	III
10.	17ITC03	Data Structures and Algorithms	ES	-	4	2	0	2	3	III
11.	17ITC08	Fundamentals of Java Programming	ES	17ITC03	4	2	0	2	3	IV

(B) Programme Core Courses (PC)			AICTE Credit Distribution Norm:48							
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1.	17ECC06	Digital Logic Design	PC	17ECC01	3	3	0	0	3	III
2.	17BMC01	Anatomy and Human Physiology	PC	17CYB05	3	3	0	0	3	III
3.	17ECP03	Digital Logic Design Laboratory	PC	17ECP01	4	0	0	4	2	III
4.	17BMP01	Human Physiology Laboratory	PC	-	4	0	0	2	2	III
5.	17ECC07	Signals and Systems	PC	17MYB02	3	3	0	0	3	IV
6.	17ECC11	Analog Circuit Design	PC	17ECC01	3	3	0	0	3	IV
7.	17BMC02	Sensors and Signal Conditioning	PC	-	3	3	0	0	3	IV
8.	17BMC03	Bio Control Systems	PC	-	3	3	0	0	3	IV
9.	17ECP06	Analog Circuit Design Laboratory	PC	17ECP01	4	0	0	4	2	IV
10.	17BMP02	Sensors and Signal Conditioning	PC	-	2	0	0	4	2	V
11.	17ECC16	Analog and Digital Communication	PC	17ECC06	3	3	0	0	3	V
12.	17BMC04	Bio Signal Processing	PC	17ECC07	3	3	0	0	3	V
13.	17BMC05	Bio Medical Instrumentation –I	PC	17BMC02	3	3	0	0	3	V
14.	17BMP03	Bio Signal Processing	PC	-	4	0	0	4	2	V

		Laboratory								
15.	17BMP04	Bio Medical Instrumentation – I Laboratory	PC	17BMP02	4	0	0	4	2	V
16.	17ECC13	Microprocessors and Microcontrollers Interfacing	PC	17ECC06	3	3	0	0	3	VI
17.	17BMC06	Medical Image Processing	PC	-	3	3	0	0	3	VI
18.	17BMC07	Bio Medical Instrumentation – II	PC	17BMC05	3	3	0	0	3	VI
19.	17ECP08	Microprocessors and Microcontrollers Interfacing Laboratory	PC	17ECP03	4	0	0	4	2	VI
20.	17BMP05	Bio Medical Instrumentation – II Laboratory	PC	17BMP04	4	0	0	4	2	VI
21.	17BMC08	Medical Imaging Techniques	PC	17BMC04	3	3	0	0	3	VII
22.	17BMC09	Rehabilitation Engineering	PC	-	3	3	0	0	3	VII
23.	17BMP06	Hospital Internship	PC	-	2	0	0	2	1	VII

(C) Elective Courses

(a)Program Specific Electives(PSE)			**AICTE Credit Distribution Norm:18**							
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1.	17MEX36	Bio Mechanics	PSE	17MEC23	3	3	0	0	3	IV
2.	17BMX01	Biomaterials	PSE	17PYB07	3	3	0	0	3	IV
3.	17BMX02	Medical Physics	PSE	17PYB01	3	3	0	0	3	V
4.	17BMX03	Telehealth Technology	PSE	-	3	3	0	0	3	V
5.	17BMX04	Artificial organs and Implants	PSE	-	3	3	0	0	3	VI
6.	17BMX05	Robotics in Medicine	PSE	17ECC06	3	3	0	0	3	VI
7.	17BMX06	Physiological Modeling	PSE	17BMC01	3	3	0	0	3	VI
8.	17BMX07	Neural Engineering	PSE	17BMC01	3	3	0	0	3	VI
9.	17BMX08	Fundamentals of Nano Science	PSE	-	3	3	0	0	3	VII
10.	17BMX09	Disaster Management	PSE	-	3	3	0	0	3	VII
11.	17BMX10	Brain Computer Interface and its applications	PSE	-	3	3	0	0	3	VII
12.	17BMX11	Virtual Instrumentation for Biomedical Engineers	PSE	-	3	3	0	0	3	VII
13.	17BMX12	Hospital Management	PSE	-	3	3	0	0	3	VII
14.	17BMX13	Medical Ethics with Standards	PSE		3	3	0	0	3	VII
15.	17GEA04	Professional Ethics and Human Values	PSE	-	3	3	0	0	3	VII
16.	17ECX12	Protocols and architectures	PSE	-	3	3	0	0	3	VIII

		for Wireless Sensor networks								
17.	17ECC21	Embedded And Real Time Systems	PSE	-	3	3	0	0	3	VIII
18.	17ECX16	Internet of Things and its applications	PSE	-	3	3	0	0	3	VII
19.	17CSX31	Problem Solving and Programming	PSE	-	3	3	0	0	3	VII
20.	17ITX26	Problem Solving and Algorithmic Skills	PSE	-	3	3	0	0	3	VI
21.	17ITC12	Database System Concepts	PSE	-	3	3	0	0	3	VIII
22.	17GEA03	Total Quality Management	PSE	-	3	3	0	0	3	VIII
23.	17ITX37	Problem Solving Using JAVA	PSE	-	3	3	0	0	3	V

(b) Open Electives			**AICTE Credit Distribution Norm:18**							
1.	17AGZ01	Baking and Confectionery Technology	OE	-	3	3	0	0	3	VII
2.	17AGZ02	Food safety and quality control system	OE	-	3	3	0	0	3	VII
3.	17AGZ03	Farm Mechanization	OE	-	3	3	0	0	3	VIII
4.	17AGZ04	Processing of Fruits and Vegetables	OE	-	3	3	0	0	3	VIII
5.	17CHZ01	Waste Water Treatment	OE	-	3	3	0	0	3	VII
6.	17CHZ02	Piping Engineering	OE	-	3	3	0	0	3	VII
7.	17CHZ03	Process Automation	OE	-	3	3	0	0	3	VII
8.	17CHZ04	Process Instrumentation	OE	-	3	3	0	0	3	VII
9.	17CEZ01	Energy conservation in buildings	OE	-	3	3	0	0	3	VII
10.	17CEZ02	Air Pollution Management	OE	-	3	3	0	0	3	VIII
11.	17CEZ03	Building Services	OE	-	3	3	0	0	3	VIII
12.	17CEZ04	Road Safety Management	OE	-	3	3	0	0	3	VII
13	17CEZ05	Waste Management	OE	-	3	3	0	0	3	VII/VIII
14.	17CSZ01	Design Thinking	OE	-	3	3	0	0	3	VII
15.	17CSZ02	Digital Marketing	OE	-	3	3	0	0	3	VII
16.	17CSZ03	Software Engineering	OE	-	3	3	0	0	3	VIII
17.	17CSZ04	Unified Functional Testing	OE	-	3	3	0	0	3	VIII
18	17CSZ05	C Programming	OE	-	3	3	0	0	3	VI
19.	17CSZ06	Data Structures	OE	-	3	3	0	0	3	VI
20.	17CSZ07	Web Services using Java	OE	-	3	3	0	0	3	VI

21.	17ECZ01	Modern wireless communication system	OE	-	3	3	0	0	3	VII
22.	17ECZ02	Consumer Electronics	OE	-	3	3	0	0	3	VII
23.	17ECZ03	Automotive Electronics	OE	-	3	3	0	0	3	VIII
24.	17ECZ04	Electronic Testing	OE	-	3	3	0	0	3	VIII
25.	17EEZ01	Renewable Energy Technology	OE	-	3	3	0	0	3	VII
26.	17EEZ02	Smart Grid	OE	-	3	3	0	0	3	VII
27	17EEZ03	Energy Auditing, Conservation and Management	OE	-	3	3	0	0	3	VIII
28	17EEZ04	Electrical Machines	OE	-	3	3	0	0	3	VIII
29	17EIZ01	Autotronix	OE	-	3	3	0	0	3	VII
30	17EIZ02	Industrial Automation	OE	-	3	3	0	0	3	VII
31.	17EIZ03	Fiber Optic Sensors	OE	-	3	3	0	0	3	VIII
32.	17EIZ04	Ultrasonic Instrumentation	OE	-	3	3	0	0	3	VIII
33.	17ITZ01	Software Testing Tool	OE	-	3	3	0	0	3	VII
34.	17ITZ02	User Experience	OE	-	3	3	0	0	3	VII
35.	17ITZ03	Developing Mobile Apps	OE	-	3	3	0	0	3	VIII
36.	17ITZ04	Software Project Management	OE	-	3	3	0	0	3	VIII
37.	17ITZ05	Java Programming	OE	-	3	3	0	0	3	VII
38.	17MEZ01	Engineering Ergonomics	OE	-	3	3	0	0	3	VII / VIII
39.	17MEZ02	Energy Audit and Resource Management	OE	-	3	3	0	0	3	VII / VIII
40.	17MEZ03	Electric Vehicle Technology	OE	-	3	3	0	0	3	VII / VIII
41.	17MEZ04	Value Engineering	OE	-	3	3	0	0	3	VII / VIII
42.	17MEZ05	Smart Mobility	OE	-	3	3	0	0	3	VII / VIII
43.	17MEZ06	Smart Sensor Systems	OE	-	3	3	0	0	3	VII / VIII
44.	17MYZ01	Mathematical Structures	OE	-	3	3	0	0	3	VII
45.	17MYZ02	Optimization Techniques	OE	-	3	3	0	0	3	VII
46.	17MYZ03	Statics for Engineers	OE	-	3	3	0	0	3	VII
47.	17MYZ04	Statistics for Engineers	OE	-	3	3	0	0	3	VII
48.	17PYZ01	Nanomaterials	OE	-	3	3	0	0	3	VII
49.	17PYZ02	Nuclear physics and Reactors	OE	-	3	3	0	0	3	VII
50..	17PYZ03	Space science and technology	OE	-	3	3	0	0	3	VII

51	17CYZ01	Chemistry for Every Day Life	OE	-	3	3	0	0	3	VII
52	17CYZ02	E - Waste Management	OE	-	3	3	0	0	3	VII
53	17CYZ03	Industrial Chemistry	OE	-	3	3	0	0	3	VII
54	17EYZ01	Communicative Hindi	OE	-	3	3	0	0	3	VII
55	17EYZ02	Fundamentals of German	OE	-	3	3	0	0	3	VII
56	17EYZ03	Basics of Japanese	OE	-	3	3	0	0	3	VII
57	17EYZ04	Employability Enhancement and Analytical Skills	OE	-	3	3	0	0	3	VII
58	17EYZ05	Workplace Communication	OE	-	3	3	0	0	3	VII
59.	17GYZ01	Biology for Engineers	OE	-	3	3	0	0	3	VII
60.	17BMZ01	Health care technology	OE	-	3	3	0	0	3	VII
61.	17BMZ02	Telemedicine	OE	-	3	3	0	0	3	VII
62.	17BMZ03	Epidemiology and Pandemic Management	OE	-	3	3	0	0	3	VII
63	17BMZ04	Medical Ethics	OE	-	3	3	0	0	3	VII
64	17EYX01	Effective Communication	OE	-	3	3	0	0	3	VII
65	17AIZ01	Fundamentals of artificial intelligence and machine learning	OE	-	3	3	0	0	3	VII
66	17AIZ02	Data science fundamentals	OE	-	3	3	0	0	3	VII
67	17AIZ03	Introduction to Business analytics	OE	-	3	3	0	0	3	VIII
68	17AIZ04	Augmented reality/virtual reality technologies	OE	-	3	3	0	0	3	VII
69	17ITZ06	Data Structures using C	OE	-	3	3	0	0	3	VII

(D) Employability Enhancement Courses			**AICTE Credit Distribution Norm:15**							
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17GED03	Personality and Character Development	EEC	-	1	0	0	1	0	VI
2	17GED06	Comprehension	EEC	ALL CORE SUBJECS	2	0	0	2	0	VII
3	17BMD01	Project Work-I	EEC	-	8	0	0	8	4	VII
4	17BMD02	Project Work-II	EEC	17BMD01	16	0	0	16	8	VIII
5	17GED07	Constitution of India	EEC	-	2	2	0	0	0	V
6	17GED08	Essence of Indian traditional knowledge	EEC	17GEP01	2	2	0	0	0	VI

Honor Degree Courses								
Vertical 1 - Optics and Wearable Technology								
S. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	17BMX14	Communication Systems	-	3	3	0	0	3
2.	17BMX15	Medical Optics	-	3	3	0	0	3
3.	17BMX16	Body Area Networks	-	3	3	0	0	3
4.	17BMX17	Medical Wearable Devices	-	3	3	0	0	3
5.	17BMX18	Telemedicine and Medical IoT	-	3	3	0	0	3
6.	17BMX19	Medical Informatics	-	3	3	0	0	3

Vertical 2 - Management in Healthcare								
S. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	17BMX20	Hospital Planning, Organization and Management	-	3	3	0	0	3
2.	17BMX21	Finance Management in Hospitals	-	3	3	0	0	3
3.	17BMX22	Human Resource Management in Hospitals	-	3	3	0	0	3
4.	17BMX23	Hospital Architecture	-	3	3	0	0	3
5.	17BMX24	Health Policy and Equipment Management	-	3	3	0	0	3
6.	17BMX25	Hospital Waste Management	-	3	3	0	0	3

Minor Degree Courses								
Healthcare Technology								
S. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C
1.	17BMM01	Introduction to Biomedical Engineering	-	3	3	0	0	3
2.	17BMM02	Bio Physics	-	3	3	0	0	3
3.	17BMM03	Biomedical Sensors	-	3	3	0	0	3
4.	17BMM04	Analytical Instrumentation	-	3	3	0	0	3
5.	17BMM05	Radiation and Nuclear Medicine	-	3	3	0	0	3
6.	17BMM06	Radiological Imaging Techniques	-	3	3	0	0	3
7.	17BMM07	ICU and Operation Theatre Equipment	-	3	3	0	0	3
8.	17BMM08	Biomaterials and Artificial Organs	-	3	3	0	0	3

SUMMARY

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3	3	0	0	3	0	0	0	9
2.	BS	10	12	3	3	3	0	0	0	31
3.	ES	10	8	9	3	0	0	0	0	30
4.	PC	0	0	10	16	13	13	7	0	59
5.	PSE	0	0	0	0	3	9	6	3	21
6.	OE	0	0	0	0	0	0	3	3	6
7.	EEC	0	0	0	0	0	0	4	8	12
CREDITS TOTAL		23	23	22	22	22	22	20	14	168

17EYA01– PROFESSIONAL ENGLISH – I *(Common to All Branches)*				
L	T	P	C
2	0	2	3

PREREQUISITE : NIL	QUESTION PATTERN: TYPE - 1

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To articulate and enunciate words and sentences clearly and efficiently using grammatical structures.	**1.1**	The students will be able to construct clear, grammatically correct sentences using a variety of sentence structures and appropriate vocabulary.	**f,i,j,l**
2.0	To acquire information through listening and apply it to persuade or articulate one's own point of view.	**2.1**	The students will be able to utilize listening skills to articulate one's own point of view in different circumstances.	**f,i,j,l**
3.0	To enable students to express themselves fluently and appropriately in social and professional contexts.	**3.1**	The students will be able to apply appropriate communication skills across settings, purposes, and audiences.	**f,i,j,l**
4.0	To summarize and paraphrase information in a text through reading skills.	**4.1**	The students will be able to distinguish main ideas and supporting details and employ active reading strategies to understand texts at the maximum level.	**f,i,j,l**
5.0	To understand different techniques and contents based on the written communication.	**5.1**	The students will be able to equip themselves with writing skills needed for academic as well as workplace contexts.	**f,i,j,l**

UNIT I – FOCUS ON LANGUAGE	**(6+6)**
Parts of Speech – Articles - Primary Auxiliaries – Modal Auxiliaries - Questions ('Yes/No' & 'Wh' Type) – Negatives - Prepositions – Conjunctions - Tenses (Simple, Continuous, Perfect, Perfect Continuous) - Vocabulary (Synonyms & Antonyms) - Homophones – Homonyms - One Word Substitution.	
UNIT II – LISTENING FOR EFFECTIVENESS	**(6+6)**
Listening to Short Conversations or Monologues - Listening to Verbal and Non-Verbal Communication – Listening to Announcements - Listening and Note-taking – Listening to Telephonic Conversations – Listening to TED/ Ink talks- Intensive listening to fill in the gapped text.	
UNIT III – COMMUNICATION BOOSTERS	**(6+6)**
Introducing Oneself – Exchanging Personal information (Likes & Dislikes) – Talking about Family & Friends - Asking about Routine Actions and Expressing Opinions - Participating in Short Conversations - Situational Talk.	
UNIT IV – PROFESSIONAL READING	**(6+6)**
Skimming – Scanning (Short Texts and Longer Passages) – Inferring Technical Texts – Reading for Interrogation – Reading Newspaper, Advertisements and Interpreting – Practicing Speed Reading - Reading Comprehension (Multiple choice / Short / Open ended Questions) - Gap Filling.	

UNIT V – TECHNICAL CORRESPONDENCE	(6+6)
Seeking Permission for Industrial Visit & In-plant Training – Checklist – Instruction - E-mail Writing - Report Writing (Accident & Survey)	
LIST OF SKILLS ASSESSED IN THE LABORATORY 1. Language Skills. 2. Listening Skills. 3. Speaking Skills. 4. Reading Skills 5. Writing Skills	
TOTAL (L:30,P:30) = 60 PERIODS	

TEXT / REFERENCE BOOKS:

1. Sudharshana, N.P and Saveetha.C. “English for Technical Communication”. New Delhi :Cambridge University Press, 2016.
2. Jackman, Vanessa and Russell, Whitehead. “Cambridge English Business Preliminary Practice Tests”. New Delhi: Oxford University Press, 2016.
3. Rizvi, Ashraf M. “Effective Technical Communication”. New Delhi: Tata McGraw Hill Publishing Company Limited, 2006.
4. Hewings, M. “Advanced English Grammar”. Chennai: Cambridge University Press, 2000.

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17MYB01 - CALCULUS AND SOLID GEOMETRY *(Common to All Branches)*					
			L	**T**	**P**	**C**
			3	**2**	**0**	**4**
PREREQUISITE : NIL		**QUESTION PATTERN: TYPE - 4**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To develop the use of matrix algebra techniques those are needed by engineers for practical applications.	**1.1**	Apply the concept of orthogonal reduction to diagonalise the given matrix.		**a,b,c,e,g,i,k**
2.0	Use the techniques, Skills and Engineering tools necessary for engineering practice, with Geometric concepts.	**2.1**	Have knowledge about the geometrical aspects of sphere.		**a,b,c,e,f,i,k**
3.0	To improve their ability in solving geometrical applications of differential calculus problems.	**3.1**	Find the radius of curvature, circle of curvature and centre of curvature for a given curve.		**a,b,c,i,k**
4.0	To learn the important role of Mathematical concepts in engineering applications with the functions of several variables.	**4.1**	Classify the maxima and minima for a given function with several variables, through by finding stationary points.		**a,b,c,d,k**
5.0	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.	**5.1**	Demonstrate the use of double and triple integrals to compute area and volume.		**a,b,c,d,f,i,k**

UNIT I – MATRICES	**(9+6)**
Characteristic Equation-Eigen values and Eigen vectors of a matrix –Properties(statement only)- Cayley Hamilton Theorem and its applications- Orthogonal transformation of a symmetric matrix to a diagonal form - Quadratic form- Reduction of a Quadratic form to canonical form by orthogonal transformation.	
UNIT II - ANALYTICAL GEOMETRY OF THREE DIMENSIONS	**(9+6)**
Equation of a Plane –Angle between two planes-Equation of straight lines-Coplanar lines- skew lines- Equation of a sphere – Orthogonal spheres.	
UNIT III - GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	**(9+6)**
Curvature – Curvature in Cartesian co-ordinates-Centre and Radius of curvature-Circle of curvature-Evolutes and Involutes-Envelopes.	
UNIT IV - FUNCTIONS OF SEVERAL VARIABLES	**(9+6)**
Partial derivatives - Euler's theorem on homogeneous function-Jacobian-Maxima and Minima of functions of two variables-Constrained Maxima and Minima by Lagrange's multiplier method.	
UNIT V - MULTIPLE INTEGRALS	**(9+6)**
Double integration in Cartesian Co-ordinates-Change of order of integration-Area as double integral- Triple integration in Cartesian Co-ordinates-Volume as triple integrals.	
TOTAL (L: 45+T:30) = 75 PERIODS	

Note : Simulation of Engineering Problems (Qualitative Analysis) using open source software

TEXT BOOKS:

1. Dr.B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna publications, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & sons, 2013.
3. Veerarajan.T, "Engineering Mathematics for Semester I & II ", Third Edition, Tata McGraw Hill,2014.

REFERENCES:

1. N.P.Bali, Manish Goyal, "A text book of Engineering Mathematics: Sem-II", 5th Edition, Laxmi Publications.2011.
2. Kandasamy .P, Thilagavathy .K , Gunavathy .K , "Engineering Mathematics for first Year", 9th Rv. Ed., S.Chand & Co Ltd, 2013.
3. Glyn James, "Advanced Engineering Mathematics", 7thEdition, Wiley India, (2007).

17PYB01- PHYSICS FOR ENGINEERS *(Common to All Branches except CSE and IT)*				
L	**T**	**P**	**C**
3	**0**	**0**	**3**

PREREQUISITE : NIL	**QUESTION PATTERN: TYPE - 1**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide the basic ideas in all the kinds of engineering branches	**1.1**	Acquire knowledge regarding Acoustics and ultrasonic	**a,e**
2.0	To develop the skills of the students in physics under various applications	**2.1**	Applying knowledge in the fields of optics & laser technology	**a,e**
3.0	To cultivate the censor designing ability of the students	**3.1**	Design the sensors using the knowledge of fiber optics	**d,e**
4.0	To provide knowledge in wave and particle physics	**4.1**	Gain the knowledge of wave, particle nature and matter waves	**b,d,e**
5.0	To provide the fundamental knowledge in basics of crystals	**5.1**	Analyze the different kind of crystal structures and crystal growth	**a**

UNIT I – ULTRASONICS & ACOUSTICS	**(9)**
Ultrasonics: Introduction - Properties of Ultrasonics- Magnetostriction and piezo electric methods. Measurement of velocity using acoustic grating- Ultrasonic A B C scan methods - Sonogram. Acoustics: characteristics of musical sound – loudness – Weber – Fechner law – absorption coefficient – reverberation – reverberation time –Factors affecting acoustics of buildings and their remedies.	
UNIT II – OPTICS & LASER TECHNOLOGY	**(9)**
Interference: Air wedge – theory – uses – testing of flat surfaces – determination of thickness of a thin wire. Types of lasers – Nd – YAG laser – CO_2 laser – semiconductor laser (homojunction & hetrojuction). Applications: Determination of particle size using laser - Holography – construction – reconstruction – Lasers in industry (Material Processing) and Medical field (Surgery)	
UNIT III – FIBER OPTICS AND SENSORS	**(9)**
Principle of light transmission through fiber - expression for acceptance angle and numerical aperture – Fabrication of optical fibers- Double crucible method - types of optical fibers (material, refractive Index profile and mode) fiber optic communication system. Splicing – Applications of optical fiber - Sensors- temperature- pressure sensor and displacement sensor Medical Endoscope.	
UNIT IV – WAVE AND PARTICLE PHYSICS	**(9)**
Development of quantum theory – de Broglie wavelength – properties of matter waves - G.P Thomson experiment - Schrödinger's wave equation – time dependent – time independent wave equations – physical significance – applications – particle in a one dimensional potential box - Compton Effect – theory and experimental verification.	
UNIT V – CRYSTALLOGRAPHY	**(9)**
Lattice – unit cell – Bravais lattices – lattice planes – Miller indices – 'd' spacing in cubic lattice – calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC and HCP structures – Crystal growth techniques- solution, melt (Czochralski) and vapour growth techniques(qualitative).	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. V. Rajendran," Engineering Physics", Tata McGraw-Hill, New Delhi, 2011.
2. G Senthilkumar. " Engineering Physics " VRB Publishers, 2011

REFERENCES:

1. P. K. Palanisami, " Physics for Engineers " Vol. 1, SciTech Pub. (India) Pvt. Ltd., Chennai, 2002.
2. M. N. Avadhanulu and P. G. Kshirsagar, "A Textbook of Engineering Physics", S. Chand & Company Ltd., New Delhi, 2005
3. R. K. Gaur and S. L. Gupta, "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2006.

17CYB02 – APPLIED ELECTRO CHEMISTRY *(Common to ECE,EEE, EIE & BME Branches)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL		**QUESTION PATTERN: TYPE - 3**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To understand the principles of water characterization and treatment methods.	**1.1**	Apply knowledge of fundamental principles of chemistry.		**a, f**
2.0	To introduce the basic concepts of electrode potential and batteries.	**2.1**	Define and solve engineering problems, including the utilization of creative and innovative skills .		**a, g**
3.0	To understand the principles and applications of corrosion.	**3.1**	Gain practical experience with chemical process equipment as well as to analyze and interpret data.		**a, c**
4.0	To provide the knowledge polymer chemistry and nanomaterials.	**4.1**	Understand the impact of engineering solutions in a global, economic, environmental and societal content.		**a, c, f**
5.0	To study about the alloys and phase rule.	**5.1**	Understand the management of electronic waste		**a, f**

UNIT I – WATER TECHNOLOGY	**(9)**
Hardness - types - estimation by EDTA method - Domestic water treatment - disinfection methods (chlorination, ozonation and UV treatment) - Boiler troubles (scale, sludge, priming, foaming and caustic embrittlement) -Internal conditioning(carbonate, phosphate and calgon) - External conditioning - demineralization process - desalination - reverse osmosis method.	
UNIT II – ELECTROCHEMISTRY	**(9)**
Electrochemistry - electrode potential - Nernst equation and problems - Reference electrode - standard hydrogen electrode - calomel electrode - potentiometric titration (redox) - conductometric titration (strong acid – strong base) - Batteries - types - lead acid battery – fuel cell – hydrogen and oxygen fuel cell.	
UNIT III – CORROSION SCIENCE	**(9)**
Corrosion - definition – types - chemical and electrochemical corrosion (mechanism) – Galvanic corrosion – Differential aeration corrosion - Pitting corrosion – Factors influencing corrosion- Corrosion control - sacrificial anode method.	
UNIT IV– POLYMERS AND NANOMATERIALS	**(9)**
Polymers - classification, addition, condensation and co polymerization - Plastics - thermoplastics and thermosetting plastics - Engineering plastics - preparation , properties and uses of PVC, teflon, PET and nylon - Polymer processing - compression and injection moulding techniques - Nanomaterials - carbon nanotubes - synthesis and their applications.	
UNIT V – PHASE RULE AND ALLOYS	**(9)**
Phase rule: Introduction, definition of terms with examples, one component system – water system – reduced phase rule – thermal analysis and cooling curves – two component systems – lead silver system – Pattinson process. Alloys : Introduction – Definition – importance and purpose of making of alloys – Ferrous alloys – Nichrome and AlNiCo – heat treatment of steel.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dr.Ravikrishnan.A, “Engineering chemistry I & Engineering Chemistry II, Sri Krishna Hitech Publishing chem Co. Pvt Ltd., 13th ed., Chennai, 2014.
2. P.C. Jain.and Monica Jain, “Engineering Chemistry”,Vol I & II, Dhanpat Rai Pub,Co., New Delhi,15th ed., 2015.

REFERENCES:

1. S.S. Dara, “A Text book of Engineering Chemistry”,S.Chand & Co. Ltd., New Delhi, 2014.
2. J. Glynn Henry and Gary W.Heinke ,”Environmental Science and Engineering,”pretice Hall of India,2014.
3. Electroplating, Anodizing and Metal treatment”, Hand book, NIIR board, Delhi, 2004.

17CSC02 - PYTHON PROGRAMMING *(Common to CSE,ECE,EEE,EIE , IT& BME Branches)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL	**QUESTION PATTERN: TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To gain knowledge about the basics of computer to solve problems	**1.1**	The students will be able to understand the working of computers.	**a,b,c,d,e,h,i,j,k,l**
2.0	To impart the fundamental concepts of Python Programming	**2.1**	The students will be able to understand the basics of Python Programming constructs	**a,b,c,d,e,h,i,j,k,l**
3.0	To gain exposure about string manipulation, list, and tuples	**3.1**	The students will be able to realize the need of strings, list, and tuples	**a,b,c,d,e,h,i,j,k,l**
4.0	To get knowledge about dictionaries, function and modules	**4.1**	The students will be able to design programs involving dictionaries and function.	**a,b,c,d,e,h,i,j,k,l**
5.0	To learn about exception handling.	**5.1**	The students will be able to develop simple programs using file concept and Modules	**a,b,c,d,e,h,i,j,k,l**

UNIT I – BASICS OF COMPUTERS & PROBLEM SOLVING	**(9)**
Computer Basics - Computer organization - Computer Software- Types of software - Software Development steps - Algorithms - Flowchart.	
UNIT II – INTRODUCTION TO PYTHON	**(9)**
History – Features – Execution of python program – Flavors of Python – Comments - Data Types - Built-in data types– Sequences - Literals– Operators – Input and Output Statements - Conditional Statements : if – if-else – Nested if-else – For – While – Nested loops – Break – Continue - pass - assert - return .	
UNIT III – STRINGS, LISTS AND TUPLES	**(9)**
Strings and Characters: Creating – Length – Indexing – Slicing – Repeating – Concatenation – Comparing - Removing Spaces - Finding Sub Strings - Counting Substrings in a String - Strings are Immutable - Replacing a String with another String - Splitting and Joining Strings - Changing Case of a String - Checking Starting and Ending of a String - Formatting the Strings - Working with Characters - Sorting Strings - Searching - Finding Number. Lists: Creating Lists – Updating - Concatenation - Repetition - Methods – Sorting. Tuples: Creating - Accessing – Operations – Functions - Nested Tuples - Inserting Elements, Modifying Elements, Deleting Elements from a Tuples.	
UNIT IV – DICTIONARIES AND FUNCTIONS	**(9)**
Dictionaries: Operations – Methods - Using for Loop with Dictionaries – Sorting the Elements of a Dictionary using Lambdas - Converting Lists and Strings into Dictionary - Passing Dictionaries to Functions - Ordered Dictionaries. Functions: Defining – Calling – Returning - Pass by Object Reference – Formal, Actual, Positional, Keyword, Default &	

Variable Length Arguments - Local and Global Variables - Recursive Functions - Lambdas - Function Decorators.	
UNIT V – FILES AND MODULES	**(9)**
Files - Types of Files - Opening & Closing a File - Working with Text Files Containing Strings - Working with Binary Files - The with Statement - The seek() and tell() Methods - Random Accessing of Binary Files - Random Accessing of Binary Files using mmap - Zipping and Unzipping Files - Working with Directories. - Modules: Importing module – Features – Built in functions.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press, 2017 Edition.

REFERENCES:

1. A.Kenneth Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.
2. Wesley J. Chun, “Core Python Programming”, Pearson Education, 2nd ed., 2010.

17ECC01– ELECTRONIC DEVICES *(Common to ECE and BME Branches)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL	**QUESTION PATTERN: TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to learn and understand the basics of Semiconductor Diodes.	**1.1**	The Students can be able to design components using basic devices.	**a,b,f,i,k**
2.0	To enable the student to understand the characteristics of Bipolar Junction Transistor.	**2.1**	The Students will be able to analyze characteristics of BJT for various operations.	**a,c,f,j**
3.0	To enable the student to understand the characteristics of Field Effect Transistor.	**3.1**	The Students will be able to understand the characteristics of Field Effect Transistor.	**a,d,i,k**
4.0	To make the students to analyze the operation of Special semiconductor diodes.	**4.1**	The students will be able to analyze the operation of Special semiconductor diodes.	**a,b,f,k**
5.0	To motivate the students to implement the project using Power devices and Display devices.	**5.1**	The Students can implement the project using Power devices and Display devices.	**a,b,c,i,l**

UNIT I – SEMICONDUCTOR DIODE	**(9)**
Semiconductors- Intrinsic and Extrinsic Semiconductors- Energy diagram of Intrinsic and Extrinsic Semiconductor- PN junction diode - Current equations - Diffusion and Drift Current Densities - Forward and Reverse bias characteristics - Switching Characteristics.	
UNIT II – BIPOLAR JUNCTION TRANSISTIOR	**(9)**
NPN and PNP – Junctions - Early effect - Current equations – Input and Output characteristics of CE, CB, CC Configurations - Ebers Moll Model - Transistor as an amplifier.	
UNIT III – FIELD EFFECT TRANSISTORS	**(9)**
JFET – Drain and Transfer Characteristics - Current equations - Pinch off voltage and its significance, MOSFET – Characteristics - Threshold voltage - Channel length modulation - D-MOSFET - E-MOSFET Current equation.	
UNIT IV – SPECIAL SEMICONDUCTOR DEVICES	**(9)**
Metal-Semiconductor Junction – MESFET – Schottky barrier diode - Zener diode - Varactor diode – Tunnel diode – PIN diode - LASER diode - LDR.	
UNIT V – POWER DEVICES AND DISPLAY DEVICES	**(9)**
UJT - SCR - Diac - Triac - Power BJT - Power MOSFET - DMOS – VMOS, LED – LCD - Photo transistor - OptoCoupler - Solar cell - CCD.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, “Electronic Devices and Circuits”, Tata McGrawHill Third Edition (2013).

REFERENCES:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, Fifth Edition, 2008.
2. Jacob Millman & Christos C. Halkias, “Electronic Devices and Circuits”, McGraw Hill, 2 nd Edition, 2007.
3. R.L. Boylestad & L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Private Limited, Ninth Edition, 2008.

17CSP02 -PYTHON PROGRAMMING LABORATORY

(Common to CSE,ECE,EEE,EIE ,IT & BME Branches)

L	T	P	C
0	0	4	2

PRE REQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To impart the fundamental concepts of Python Programming	**1.1**	The students will be able to understand the basics of Python Programming constructs	**a,c,j**
2.0	To learn the operator concepts of Python Programming	**2.1**	The students will be able to understand the various operators of Python Programming.	**a,b,k**
3.0	To gain exposure about string manipulation, list, and tuples	**3.1**	The students will be able to realize the need of string manipulation, list, and tuples	**a,b,c,i,k**
4.0	To get knowledge about dictionaries, function and modules	**4.1**	The students will be able to design programs involving dictionaries, function and modules	**a,b,c,i,k**
5.0	To learn about exception handling	**5.1**	The students will be able to develop simple programs with exception handling	**a,b,e,i**

Python-Programming

1. Program using Operators
2. Program using Conditional Statements
3. Program using Looping
4. Program using Strings
5. Program using Lists
6. Program using Dictionaries
7. Program using Tuples
8. Program using Functions
9. Program using File handling
10. Program using Modules

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

Hardware

1. LAN System with 33 nodes (OR) Standalone PCs – 33 Nos, Printers – 3 Nos.

Software

- OS – Windows / UNIX Clone
- Open Source Software – Python

TOTAL (P:60) = 60 PERIODS

17GYP02 ENGINEERING PRACTICES LABORATORY *(Common to All Branches)*				
L	**T**	**P**	**C**
0	**0**	**4**	**2**

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To provide hands on training on various basic engineering practices in Civil Engineering	**1.1**	The students will be able to understand various civil engineering practices like plumbing, carpentry and relevant tools	**a, d, f, i, k, l**
2.0	To provide hands on training on various basic engineering practices in Mechanical Engineering	**2.1**	The students will be able to understand various manufacturing processes like welding, machining and sheet metal work	**a, d, f, i, k, l**
3.0	To understand the basic working principle of electric components	**3.1**	The students will be able to do residential house wiring and Measure energy and resistance to earth of an electrical equipment	**a,e,f,h**
4.0	To understand the basic working principle of electronic components	**4.1**	The students will be able to perform the assembling and testing of the PCB based electronic circuits.	**a,j,k,l**
5.0	To develop the skill to make / operate/utilize the simple engineering components	**5.1**	The students will be able to make / operate / utilize the simple engineering components.	**e, j**

GROUP-A (MECHANICAL AND CIVIL ENGINEERING)

I - CIVIL ENGINEERING PRACTICE **(15)**

Buildings:

a. Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects

Plumbing Works:

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings
b. Study of pipe connections requirements for pumps and turbines
c. Preparation of plumbing line sketches for water supply and sewage works
d. Hands-on-exercise:

   Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components
e. Demonstration of plumbing requirements of high-rise buildings

Carpentry using Power Tools only:

a. Study of the joints in roofs, doors, windows and furniture
b. Hands-on-exercise: Planning, Tee joints.

II - MECHANICAL ENGINEERING PRACTICE **(15)**

Welding:

a. Preparation of edges for welding and study of welding symbols
b. Arc welding- butt joints, lap joints and tee joints
c. Gas welding
d. Study of standard size of bars, rods, sections, sheet metals
e. Study of work piece types and parameters of welding such as welding current, air gap, filler metal

Basic Machining:

a. Facing & Plain turning
b. Drilling Practice
c. Study of different types of screw drivers, screws, bolts and nuts

Sheet Metal Work:

a. Model making using bending and forming - Trays, cone
b. Study of thickness gauges, wire gauges

GROUP - B (ELECTRICAL AND ELECTRONICS)

I - ELECTRICAL ENGINEERING PRACTICE	**(15)**

a. Residential house wiring using switches, fuse, indicator, lamp and energy meter
b. Fluorescent lamp wiring
c. Stair case wiring
d. Measurement of electrical quantities - voltage, current, power& power factor in RLC circuit
e. Measurement of energy using single phase energy meter
f. Measurement of resistance to earth of electrical equipment.

II - ELECTRONICS ENGINEERING PRACTICE	**(15)**

a. Study of Electronic components - Resistor (Colour coding), Inductor, Capacitor.
b. Measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.
c. Study of logic gates AND, OR, XOR and NOT.
d. Study of Clock Signal.
e. Soldering practice -Components Devices and Circuits - Using general purpose PCB.
f. Study of Half Wave Rectifier (HWR) and Full Wave Rectifier (FWR).
g. Study of Telephone, FM Radio and Cell Phone.

TOTAL(P:60): 60 PERIODS

17GEP01 - Personal Values *(Common to All Branches)*					
		L	**T**	**P**	**C**
		0	**0**	**2**	**0**
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To make students to learn individual in knowing them self	**1.1**	Become an individual in knowing the self	**a, f**	
2.0	To enable the student to understand Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.	**2.1**	Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness &fitness.	**a, g**	
3.0	To enable the student to understand physical exercise and breathing techniques	**3.1**	Practice simple physical exercise and breathing techniques	**a, c**	
4.0	To make the students to Yoga asana which will enhance the quality of life.	**4.1**	Practice Yoga asana which will enhance the quality of life.	**a, c, f**	
5.0	To motivate the students to Practice Meditation and get benefited	**5.1**	Practice Meditation and get benefited.	**a, f**	

Values through Practical activities:

1.Knowing the self

Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.

2. **Mental Health**

Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.

3.Physical Health

Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.

4.Core value Self love& Self care:

Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.

5.Fitness

Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi suddhi pranayama – Silent sitting and listening to nature – Meditation.

TOTAL(P:30): 30 PERIODS

REFERENCES:

1. Know yourself -socrates - pdf format at www.au.af.mil/au/awc/awcgate/army/rotc_self-aware.pdf.
2. Steps to knowledge: the book of inner knowing-pdf format at www.newmessage.org/wp content/uploads/pdfs/books/stk_nkl_v1.5.pdf.
3. Promoting mental health - world health organization -pdf.
4. www.who.int/mental_health/evidence/mh_promotion_book.pdf.
5. Learning to be: a holistic and integrated approach to values-unesco pdf format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf.
6. Personality development by swami Vivekananda -www.estudantedavedanta.net/personality- development.pdf.

17EYA02 – PROFESSIONAL ENGLISH – II (*Common to All Branches)*				
	L	**T**	**P**	**C**
	2	**0**	**2**	**3**
PREREQUISITE : 17EYA01	**QUESTION PATTERN : TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To enable students to get familiar with words, phrases and sentences relevant to the immediate communication tasks.	**1.1**	The students will be able to communicate using a variety of sentence structures and appropriate vocabulary.	**f,i,j,l**
2.0	To help students to develop their listening skills and comprehend them by asking questions.	**2.1**	The students will be able to comprehend conversations and short talks delivered in English and respond accordingly.	**f,i,j,l**
3.0	To enhance students' speaking skills by making them to participate in Technical Presentation, Group Discussion, etc.	**3.1**	The students will be able to speak appropriately and effectively in various situations.	**f,i,j,l**
4.0	To inculcate reading habit and to develop effective reading skills.	**4.1**	The students will be able to employ active reading strategies to understand texts at the maximum level.	**f,i,j,l**
5.0	To foster the ability to write convincing Job Application and effective Formal Letters.	**5.1**	The students will be able to equip themselves with writing formal letters and winning Job Application.	**f,i,j,l**

UNIT I - LANGUAGE DEVELOPMENT	**(6+6)**
Vocabulary (Prefixes & Suffixes) - Active Voice and Passive Voice - Impersonal Passive Voice – Conditional Clauses – Subject - Verb Agreement - Direct and Indirect Speech - Idioms and Phrases - Discourse Markers - Error Spotting.	
UNIT II – LISTENING COMPREHENSION	**(6+6)**
Listening for Specific Information and Match / Choose / Fill in the texts - Short Films, News, Biographies, Roles and Responsibilities in Corporate, Funny Shows – Listening to Iconic Speeches and making notes – Listening to Interviews.	
UNIT III – ACQUISITION OF ORAL SKILLS	**(6+6)**
Describing a Person - Making Plans – Asking for and Giving Directions - Talking about Places - Talking over Phone – Narrating Incidents – Introduction to Technical Presentation - Story Telling – Group Discussion.	
UNIT IV – READING NUANCES	**(6+6)**
Intensive Reading – Extensive Reading – Finding key information in a given text - Reading and Understanding Technical Articles - Reading and Interpreting Visual Materials.	
UNIT V – EXTENDED WRITING	**(6+6)**
Job Application with Resume – Recommendation – Inviting Dignitaries - Accepting & Declining Invitation - Paragraph Writing (Topics and Images).	

LIST OF SKILLS ASSESSED IN THE LABORATORY

1. Language Skills.
2. Listening Skills.
3. Speaking Skills.
4. Reading Skills
5. Writing Skills

TOTAL (L:30, P:30) = 60 PERIODS

TEXT / REFERENCE BOOKS:

1. Kumar, Suresh. E. "Engineering English". Orient Blackswan : Hyderabad, 2015.
2. Raman, Meenakshi and Sangeetha Sharma. "Technical Communication Principles and Practice". Oxford University Press: New Delhi, 2014.
3. Board of Editors. "Fluency in English – A Course Book for Engineering and Technology".Orient Blackswan: Hyderabad, 2016.
4. Comfort, Jeremy, et al. "Speaking Effectively: Developing Speaking Skills for Business English". Cambridge University Press: Cambridge, 2011.

17MYB02 – COMPLEX ANALYSIS AND LAPLACE TRANSFORMS *(Common to All branches)*					
		L	**T**	**P**	**C**
		3	**2**	**0**	**4**
PREREQUISITE : 17MYB01		**QUESTION PATTERN : TYPE - 4**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To expose the concepts of differential equations.	**1.1**	Predict the suitable method to solve second and higher order differential equations	**a, b, c, d, f, i, k**	
2.0	To communicate the problem solutions using correct Mathematical terminology of vector calculus.	**2.1**	Apply the concepts of Differentiation and Integration to Vectors.	**a, b, c, f, g, k**	
3.0	Apply rigorous and analytic approach to analyse the conformal mapping.	**3.1**	Compute an analytic function, when its real or imaginary part is known.	**a, b, c, d, e, i, k**	
4.0	Acquiring the knowledge of evaluating contour integrals using residue theorem.	**4.1**	Identify the Singularities and its corresponding Residues for the given function.	**a, b, c, d, e, k**	
5.0	Apply the concepts of Laplace transforms and its applications to various problems related to Engineering.	**5.1**	Predict a suitable method to evaluate the Contour integration.	**a, b, c, d, e, f, i, k**	

UNIT I - ORDINARY DIFFERENTIAL EQUATIONS	**(9+6)**
Higher order linear differential equations with constant coefficients - method of variation of parameters - Cauchy's and Legendre's linear equations	
UNIT II - VECTOR CALCULUS	**(9+6)**
Gradient and Directional derivative -Divergence and Curl – Irrotational,solenoidal and scalar potential –Line integral over a plane curve-Surface Integral and Volume Integral-Green's theorem in a plane-Gauss divergence theorem and Stokes Theorem (Excluding Proofs)-Simple Applications Involving Square, Rectangles, Cube and Parallelopiped.	
UNIT III- ANALYTIC FUNCTIONS	**(9+6)**
Functions of a complex variable-Analytic functions– Necessary and sufficient conditions of Cauchy's -Riemann Equations in Cartesian Coordinates (Excluding Proofs) – Properties of Analytic Functions – Harmonic conjugate – Construction of an analytic function by Milne's Thomson Method– Conformal mapping :w = c+z , cz, 1/z and Bilinear Transformation.	
UNIT IV - COMPLEX INTEGRATION	**(9+6)**
Statement and Simple applications of Cauchy's integral theorem and Cauchy's integral formula(Excluding Proofs) – Taylor's and Laurent's Series Expansions - Singularities - Residues – Cauchy's Residue theorem (Statement only) – Evaluation of contour integration over unit circle and semi circle (Excluding poles on Real axis).	
UNIT V- LAPLACE TRANSFORM	**(9+6)**
Condition for existence - Transforms of Elementary functions –Basic Properties- First & Second Shifting Theorems (Statement only) –Transforms of derivatives and integrals- Transform of periodic functions - Initial and Final value Theorems. Inverse Laplace transforms -Convolution theorem (Statement only) –Solution of linear second order Ordinary differential equations with constant coefficients using Laplace transforms.	
TOTAL (L: 45+T:30) = 75 PERIODS	

Note : Simulation of Engineering Problems (Qualitative Analysis) using open source software

TEXTBOOKS:

1. Dr.B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna publications, 2012
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley and sons, 2013
3. Veerarajan.T, "Engineering Mathematics for Semester I and II", 3rd Edition, Tata McGraw Hill, 2014

REFERENCES:

1. N.P.Bali and Manish Goyal, "A text book of Engineering Mathematics : Semester-II", 5th Edition, Laxmi Publications, 2011
2. Kandasamy .P, Thilagavathy .K and Gunavathy .K, "Engineering Mathematics for first Year", 9th Rv. Ed., S.Chand and Co Ltd, 2013
3. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Wiley India, 2007.

17PYB07 – PHYSICS FOR BIOMEDICAL ENGINEERS *(For BME branch Only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE: 17PYB01	**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide the basic ideas in electrical conduction, and electron distribution in metals	**1.1**	Acquire knowledge about conduction process in metals.	**a,b**
2.0	To understand the concept of magnetism and super conducting properties of materials	**2.1**	Understanding the origin of magnetic field and super conduction.	**a,b**
3.0	To provide the basic knowledge in applications of light- matter interaction.	**3.1**	Understand the applications of radiation based instruments.	**a,e**
4.0	To attain the knowledge in recent development high resolution imaging systems	**4.1**	Understanding the importance of imaging systems in engineering and medial field.	**a,e,f**
5.0	To update the recent development in modern engineering materials	**5.1**	Know of recent trends in nanotechnology and biomaterials	**d,e,f**

UNIT I - CONDUCTING MATERIALS	**(9)**
Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.	
UNIT II – MAGNETIC AND SUPERCONDUCTING MATERIALS	**(9)**
Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications. Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) – Applications of superconductors – SQUID, cryotron, magnetic levitation.	
UNIT III – RADIATION PHYSICS	**(9)**
Ionizing and Non Ionizing radiation – X ray radiography and its types – fluoroscopy – Fluorescence and Phosphorescence – Beer‟s Law - UV visible spectrometer – Vibrations of organic molecules – Infrared spectroscopy (FTIR).	
UNIT IV - IMAGING SYSTEMS	**(9)**
Magnification – Microscope – Electron Microscope – Scanning Electron microscope - Transmission Electron Microscope – STEM (qualitative) – Nuclear Magnetic resonance – MRI scanning method - ECG , PCG and EEG(Qualitative).	
UNIT V - ADVANCED ENGINEERING MATERIALS	**(9)**
Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications	

TOTAL (L: 45) = 45 PERIODS
TEXT BOOKS: 1. V.Rajendran, “Engineering Physics”, Tata McGraw-Hill. New Delhi.2011. 2. Gaur R K and Gupta S L, “Engineering Physics”, Dhanpat Rai and Sons, New Delhi, 2013
REFERENCES: 1. Thiruneelakandan. R, “Material Science”, Gems publishers, 2015. 2. G.Senthil Kumar, N.Iyandurai, “Physics-II”, VRB Publishers, 2005-2006, Revised Edition. 3. S.O. Pillai, “Solid State Physics”, New Age International Publications, New Delhi, 2010. 4. Avadhanulu.M.N, Kshirsagar.P.G, “A Text book of Engineering Physics”, S.Chand, 2011.

17CYB05 – CHEMISTRY FOR BIOMEDICAL ENGINEERS *(FOR BME BRANCH ONLY)*					
			L	T	P	C
			3	0	0	3
PREREQUISITE: NIL		**QUESTION PATTERN : TYPE - 3**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To understand the concept of biochemistry.	**1.1**	Apply knowledge of fundamental of biochemistry		**a,b,c,k**
2.0	The students should be conversant with structural and fundamental functional properties of carbohydrates	**2.1**	Explain how the properties of carbohydrates impact on the processing and quality of the finished products		**a,d,e,g,d**
3.0	To ensure students to having strong foundation in lipids nomenclature and their properties.	**3.1**	Recognize lipid structures including lipids found in cell membranes and their transport across membranes.		**a,b,e,k**
4.0	To gain knowledge on enzyme and its clinical application.	**4.1**	Describe the chemical nature of enzymes and their function in biochemical reactions.		**a,c,f,g**
5.0	To emphasize the role of Microorganism and immunological techniques.	**5.1**	Provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry		**a,e,h,k**

UNIT I - INTRODUCTION TO BIOCHEMISTRY	**(9)**
Introduction to biochemistry – water – biological importance of water – water as a biological solvent - weak acid and bases - pH - buffers – biological buffers – biological buffer system: phosphate buffer system - bicarbonate buffer system - protein buffer system - Haemoglobin buffer system. Henderson – Hasselbalch equation – Adsorption – Diffusion – Osmosis - biological applications.	
UNIT II – CARBOHYDRATES	**(9)**
Classification of carbohydrates – monosaccharides – Structure: trioses – tetroses – pentoses – hexoses – heptoses. properties of monosaccharides – Disaccharides – Structure: maltose – lactose – sucrose. Oligosaccharides – Raffinose – Polysaccharides – starch – Isomerism in carbohydrates - racemisation and mutarotation.	
UNIT - III LIPIDS	**(9)**
Classification of lipids – simple - complex - derived lipids - Nomenclature of fatty acids - physical and chemical properties of fat - Metabolic pathways - synthesis and degradation of fatty acids (beta oxidation) - hormonal regulation of fatty acid metabolism.	
UNIT IV - ENZYME AND ITS CLINICAL APPLICATIONS	**(9)**
Classifications of enzymes - Kinetics of Enzymes – Michaelis – Menten equation - Factors affecting enzymetic activity - temperature - pH – concentration of substrate - Enzyme concentration – product concentration – activators - Enzyme inhibitors - reversible inhibitors - competitive - non competitive – irreversible inhibitors – active site directed irreversible inhibitors – Suicide inhibitors – Difference between reversible and irreversible inhibitors.	
UNIT V - MICROBIOLOGY AND IMMUNOPATHOLOGY	**(9)**
Scope and applications of Microbiology – Microorganisms – Physical and chemical control of microorganisms – Sterilization: Moist heat - dry heat - radiation - filtration. Disinfection: phenol – alcohol – detergents. Immunological techniques: Immuno electrophoresis – RIA – ELISA.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Lehninger, A.L,Nelson D.L. and Cox,M.M, " Principles of Biochemistry", Freeman Publishers, New York, 4th edition, 2005.
2. Prasad B.N., "A Text Book of Biotechnology", Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal. 2003.

REFERENCES:

1. Keith Wilson & John Walker , "practical bio chemistry – principles & techniques", oxford University Press, 2009
2. Donald Voet , Judith G.Voet , wiley , John & sons, Biochemistry : third editon.2003
3. Dubey RC and Maheswari DK. – A Text of Microbiology II Chand and Company Ltd,2007
4. U Satyanarayana, Biochemistry,, Elsevier Health Sciences ; Fourth Edition , 2014

17MEC01 – ENGINEERING GRAPHICS *(Common to All Branches except CSE and IT)*					
		L	**T**	**P**	**C**
		2	**2**	**0**	**3**
PREREQUISITE : NIL		**QUESTION PATTERN: TYPE - 2**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To gain knowledge about conic sections and plane curves.	**1.1**	The Students can be able to construct conic sections and special curves of required specifications.	**a, c, d, e, i, k, l**
2.0	To learn the concept of first angle projection of points, lines and plane	**2.1**	The Students can be able to apply the concept of first angle projection to create project of straight lines, planes, solids and section of solids.	**a, c, d, i, k, l**
3.0	To understand and familiarize with the projection of solids	**3.1**	The Students can be able to develop a surface drawing of a solid model with given dimensions.	**a, c, d, e, i, k, l**
4.0	To learn the concept of sectioning of solids and developing the surfaces	**4.1**	The Students can be able to build orthographic, isometric projections of a three dimensional object.	**a, c, d, i, k, l**
5.0	To understand the orthographic, isometric and perspective projections of three dimensional objects	**5.1**	The Students can be able to make use of the knowledge of engineering drawing to create physical models.	**a, c, d, i, k, l**

CONCEPTS AND CONVENTIONS:

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

UNIT I - PLANE CURVES	**(6+6)**

Basic Geometrical constructions, Curves used in engineering practices - Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves - Theory of Projection - Principle of Multi-view Orthographic projection - Profile plane and Side views - Multiple views - Representation of Three Dimensional objects - Layout of views

UNIT II - FIRST ANGLE PROJECTION OF POINTS, LINES AND PLANE	**(6+6)**

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

UNIT III - PROJECTION OF SOLIDS	**(6+6)**

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

UNIT IV - SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	(6+6)
Sectioning of solids (Prism, Cube, Pyramid, Cylinder and Cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.	
UNIT V - ISOMETRIC, ORTHOGRAPHIC AND PERSPECTIVE PROJECTIONS	**(6+6)**
Principles of isometric projection - Isometric scale - Isometric projections of lines, plane figures, simple solids and truncated solids - Prisms, pyramids, cylinders, cones - combination of two solid objects in simple vertical positions - Free hand sketching of Orthographic views from Isometric views of objects. Perspective projection of simple solids - Cube, Prisms and pyramids by visual ray method	
TOTAL (L:30+T:30) = 60 PERIODS	

TEXT BOOKS:

1. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2013.
2. N.S Parthasarathy and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCES:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) Subhas Stores, Bangalore, 2007
3. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
4. Dr. M. Saravanan, Dr. M. Arockia Jaswin and J. Bensam Raj, "Engineering Graphics", Tri Sea Publications.
5. Luzzader, Warren.J., and Duff, John M, "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
6. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009

INSTRUMENT: ***Use of Mini drafter is compulsory***

Special points applicable to End Semester Examinations on Engineering Graphics:

1. The answer paper shall be of A3 size drawing sheets.
2. Minimum one question and not more than two questions from a unit.
3. Question paper consists of Part A and Part B.
4. Part A: One compulsory question carries 20 marks from any one of five units.
5. Part B: 4 out of 8 open choice questions carry 20 marks each.

17ECC03- CIRCUIT THEORY *(Common to ECE & BME Branches)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE - 3**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to learn and understand the basics of Electrical circuits.	**1.1**	The Students can apply the Ohm's law and Kirchhoff's law and investigates the behavior of electric circuits by analytical techniques.	**a,b,f,i,k**
2.0	To enable the student to Evaluate the voltage, current of electric circuit using Graph theory techniques	**2.1**	The Students will be able to Evaluate the voltage, current of electric circuit using Graph theory techniques	**a,c,f,j**
3.0	To enable the student to Design simple network for the complex network by exploring circuit theorems.	**3.1**	The Students will be able to Design simple network for the complex network by exploring circuit theorems.	**a,d,i,k**
4.0	To motivate the students to implement the project using transient response of DC circuits.	**4.1**	The students will be able to Design and test the dc and ac transient circuits using test signals.	**a,b,f,k**
5.0	To make the students to design the resonance circuit and coupled circuits.	**5.1**	Design and test circuit for a desired cut off frequency using resonant and coupled circuits.	**a,b,c,i,l**

UNIT I - BASICS OF CIRCUIT ANALYSIS	**(9)**
Basic components and electric circuits, voltage and current laws, Resistors and Capacitors – series and parallel circuits, Basic mesh and nodal analysis, source transformation techniques-Star delta transformation techniques.	
UNIT II -NETWORK THEOREMS FOR DC CIRCUITS	**(9)**
Network Reduction: Voltage and Current Division, - Thevenin's theorem - Norton's theorem- Super position theorem- Maximum power transfer theorem- Reciprocity theorem.	
UNIT III- NETWORK THEOREMS FOR AC CIRCUITS	**(9)**
Impedance and Admittance for R, L and C elements, Thevenin's theorem - Norton's theorem- Super position theorem- Maximum power transfer theorem- Reciprocity theorem.	
UNIT IV –TRANSIENTS	**(9)**
Differential equations / Laplace Transform - Steady state and transient response: DC response of RL, RC and RLC circuit - Sinusoidal response of RL, RC and RLC circuits.	
UNIT V-RESONANCE AND COUPLED CIRCUITS	**(9)**
Resonance: Natural frequency and Damping Ratio - Series Resonance - Parallel Resonance-Quality Factor. Coupled Circuits: Self-inductance- Mutual inductance, Dot conversion-Coupling Coefficient. Tuned Circuits-Single Tuned circuits.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis," 8th edition., Tata McGraw Hill publishers, New Delhi, 2013.

REFERENCES :

1. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis,” Tata McGraw Hill, 2007.
2. Chakrabati A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
3. Nageswara Rao.T, “Circuit Theory”, A.R. Publications, Chennai, 2014.
4. Joseph Edminister and MahmoodNahri, Theory and Problems of Electric Circuits Tata McGraw- Hill, 2008.

17GYP01 - PHYSICS AND CHEMISTRY LABORATORY *(Common to All Branches Except CSE and IT)*				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**
PREREQUISITE: NIL				

COURSE OBJECTIVES AND OUTCOMES

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide the basic practical exposure to all the engineering and technological streams in the field of physics.	**1.1**	Acquire the fundamental knowledge in optics such as interference, Diffraction and Understand about the spectral instruments etc	**a,b,d,g,l**
2.0	To provide the basic practical exposure to all the engineering and technological streams in the field of chemistry	**2.1**	Gain the basic knowledge about handling the laser light and Identify the basic parameters of an optical fibre.	**a,b,d,g**
3.0	The students are able to know about the water containing impurities and some physical parameters	**3.1**	Analyze the properties of matter with sound waves.	**a,b,d**
4.0	To gain the knowledge about light, sound, laser, fiber optics and magnetism	**4.1**	Apply knowledge of measurement of hardness producing ions, chloride, alkalinity, DO, conductance, EMF and pH	**a,b,d,g**
5.0	To develop the knowledge of conductometric titration and viscometry	**5.1**	Understand the impact of water quality and solve engineering problems.	**a,b,d,g**

Physics Laboratory (Any Five – Branch specific)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

Chemistry Laboratory (Any Five)

1 Determination of total, temporary & permanent hardness of water by EDTA method.
2 Determination of alkalinity in water sample.
3 Determination of chloride content of water sample by argentometric method.
4 Conductometric titration of strong acid vs strong base.
5 Estimation of iron content of the given solution using potentiometer.
6 Determination of strength of given hydrochloric acid using pH meter
7 Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
8 Estimation of iron content of the water sample using spectrophotometer

TOTAL(P:60): 60 PERIODS

17ECP01 – CIRCUITS AND DEVICES LABORATORY *(Common to ECE & BME Branches)*					
			L	**T**	**P**	**C**
			0	**0**	**4**	**2**
PREREQUISITE : 17ECC01– ELECTRONIC DEVICES					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To make students to learn and practice the basics of Semiconductor Diodes.	**1.1**	The Students can be able to analyze the characteristics of diodes and transistors.	**a,b,e,k**	
2.0	To enable the student to analyze the characteristics of Bipolar Junction Transistor and Field Effect Transistor.	**2.1**	The Students will be able to evaluate the characteristics of electronic devices such as FET, UJT and SCR etc based on their operations.	**a,b,f,k**	
3.0	To provide the student with practice in the experimental setup of basic electronic circuits.	**3.1**	The Students will be able to verify the characteristics of clipper and clamper.	**a,j,l**	
4.0	To make the students to learn and practice with measurement of electrical networks.	**4.1**	The students will be able to verify the theorems such as Thevenin's theorem, Norton theorems etc.	**b,d**	
5.0	To motivate the students to implement the project using electronic devices and display devices.	**5.1**	The Students will be able to measure the voltage and frequency using resonance circuits.	**c,g**	

LIST OF EXPERIMENTS:

1. Characteristics of PN junction diode and Zener diode
2. Input-Output characteristics of common emitter configuration.
3. Input-Output characteristics of common base configuration.
4. FET characteristics.
5. UJT characteristics.
6. SCR characteristics.
7. Verification of Thevenin's theorem.
8. Verification of Norton's theorem.
9. Verification of KVL, KCL.
10. Verification of super position theorem and reciprocity theorem.
11. Determination of resonance frequency of series and parallel circuits.

TOTAL (P: 60) = 60 PERIODS

17GEP02- INTER PERSONAL VALUES *(Common to All Branches)*					
		L	T	P	C
		0	0	2	0
PREREQUISITE: 17GEP01					
COURSE OBJECTIVES AND OUTCOMES					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To know interpersonal values.	**1.1**	Develop a healthy relationship & harmony with others.	**a, f**	
2.0	To train the students to maneuver their temperaments.	**2.1**	Practice respecting every human being.	**a, g**	
3.0	To achieve the mentality of appreciating core values of a person.	**3.1**	Practice to eradicate negative temperaments.	**a, c**	
4.0	To analyze the roots of problems and develop a positive attitude about the life.	**4.1**	Acquire Respect, Honesty, Empathy, Forgiveness and Equality.	**a, c, f**	
5.0	To understand the effects of physical activities on mental health.	**5.1**	Practice Exercises and Meditation to lead a healthy life and Manage the cognitive abilities of an Individual.	**a, f**	

UNIT II – INTRODUCTION	**(6)**
Introduction to interpersonal values – Developing harmony with others –Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.	
UNIT II - MANEUVERING THE TEMPERAMENTS	**(6)**
From Greed To Contentment - Anger To Tolerance -Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.	
UNIT III - CORE VALUE	**(6)**
Truthfulness **-** Honesty –Helping–Friendship – Brotherhood – Tolerance –Caring & Sharing – Forgiveness – Charity – Sympathy — Generosity – Brotherhood -Adaptability.	
UNIT IV – PATHWAY TO BLISSFUL LIFE	**(6)**
Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.	
UNIT V - THERAPEUTIC MEASURES	**(6)**
Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.	
TOTAL(P:30): 30 PERIODS	

REFERENCES:

1. Interpersonal Skills Tutorial (Pdf Version) – TutorialsPoint www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. Interpersonal relationships at work - Ki Open Archive – Karolinska www.publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1
3. Values education for peace, human rights, democracy – UNESCO. www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. Maneuvering Of Six Temperaments - Vethathiri Maharishi. www.ijhssi.org/papers/v5(5)/F0505034036.pdf
5. The Bliss of inner fire: Heart practice of the six. – Wisdom Publications - www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pd

17MYB05 -TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (*Common to BME,EEE,ECE and E&I Branches)*				
L	**T**	**P**	**C**
2	**2**	**0**	**3**
PREREQUISITE : 17MYB02	**QUESTION PATTERN : TYPE -4**		

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the concept of Fourier Series and enhance the problem solving skill.	**1.1**	The students will be able to analysis the Fourier series problem.	**a,b**
2.0	To develop the skills of the students in the areas of Transforms and Partial Differential Equations.	**2.1**	Know the formation of partial differential equations.	**a,b,c**
3.0	To introduce the effective mathematical tools for the solutions of partial differential equations.	**3.1**	Apply the partial differential equations to solve the various electrical and electronics application.	**b,g**
4.0	To acquaint the student with Fourier transform techniques used in wide variety of situations.	**4.1**	Solve the problems using Fourier integral theorem and convolution theorem technique.	**a,c,g**
5.0	To develop Z transform techniques for discrete time Systems.	**5.1**	Formulate the difference equations and solve them using Z-transform techniques.	**a,b,g**

UNIT I - FOURIER SERIES	**(6+6)**
Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine series – Half range cosine series - Parseval's identity – RMS value - Harmonic Analysis.	
UNIT II - PARTIAL DIFFERENTIAL EQUATIONS	**(6+6)**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the type f(p,q)=0,Clairut's form – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.	
UNIT III - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	**(6+6)**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation (Zero and Non-zero Velocity) – One dimensional heat equation (Temperature Reduced to zero and Non-zero boundary conditions) – Steady state solution of two-dimensional heat equation (Finite and Infinite Plate).	
UNIT IV - FOURIER TRANSFORMS	**(6+6)**
Fourier integral theorem (statement only) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem– Parseval's Identity(Excluding proof).	
UNIT V - Z -TRANSFORM AND DIFFERENCE EQUATIONS	**(6+6)**
Z transforms -Elementary properties – Inverse Z transform (Partial fraction method and Residue method) – Convolution theorem (Excluding proof) –Formation of difference equations – Solution of difference equations using Z transform.	
TOTAL (L: 30+T:30) = 60 PERIODS	

TEXT BOOKS:

1. Veerarajan,T. "Engineering mathematics (for III Semester)", 3rd ed., Tata Mc Graw Hill, New Delhi, 2005
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics; Volume III", S. Chand & Co Ltd., 2008.

REFERENCES:

1. Goyal. Manish and Bali, N.P, "A Textbook of Engineering mathematics", 6th ed., Laxmi Publication (P) Ltd. New Delhi, 2012.
2. Grewal, B.S. "Higher Engineering Mathematics", 42nd ed., Khanna publishers, New Delhi, 2012.
3. Kreyszig, Erwin. "Advanced Engineering Mathematics", 9th ed., Wiley Publications, New Delhi, 2006.
4. Singaravelu.A, "Transforms and Partial Differential Equations", Reprint Edition 2013, Meenakshi Publications, Tamil Nadu.

17ECC23 BASICS OF ELECTRICAL ENGINEERING (*Common to BME,EEE,ECE and E&I Branches)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.	**1.1**	Predict the behavior of any electrical and magnetic circuits.	**a,b**
2.0	Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.	**2.1**	Formulate and solve complex AC, Dc circuits.	**a,b**
3.0	To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments	**3.1**	Identify the type of electrical machine used for that particular application.	**a,e**
4.0	Acquire knowledge of principle of calibration of a measuring instrument	**4.1**	Knowledge on different measuring equipments	**a,e,f**
5.0	Acquire knowledge of principle of calibration of a measuring instrument	**5.1**	Exercise and practical exposure on safety measure in electrical wring	**d,e,f**

UNIT I : ELECTRICAL CIRCUITS AND ANALYSIS	**(9)**
Ohm's law, DC and AC circuits fundamentals, Energy sources, Kirchhoff„s laws, Mesh and Nodal analysis, Star - delta and Delta -star transformation; theorems and simple problems :Superposition, Thevenins„s, Maximum power transfer theorem.	
UNIT II : ELECTRICAL MACHINES	**(9)**
DC Machines: D.C generators &D.C motors: Principle of operation, constructions, types, Applications -A.C Machines: Types-Introduction to Alternators-Single Phase and Three phase induction motors: principle of operation, Types and Applications-Transformers : Principles of operation, Constructional Details, Types and Applications.	
UNIT : III BASIC ELECTRICAL INSTRUMENTATION	**(9)**
Introduction, classification of instruments, operating principles, essential features of measuring instruments (elementary Treatment only)- Moving coil , permanent magnet (PMMC) instruments, Moving Iron of Ammeters and Voltmeters Energy meter, Current Transformer, Potential Transformer.	
UNIT IV : ELECTRICAL WIRING AND SAFETY	**(9)**
Cable and wire types and applications, Service mains, meter board and distribution board. Brief discussion on concealed conduit wiring. Two-way and three-way control. Elementary discussion on Circuit protective devices: fuse and Miniature Circuit Breaker (MCB„s). Electric shock, precautions against shock, Objectives for Neutral and Earthing, types of earthing; pipe and plate earthing, Residual current circuit breaker.	
UNIT V : ELECTRICAL POWER SYSTEM AND ITS APPLICATION	**(9)**
Introduction to Power generation, distribution and Transmission. Power supply circuits with SMPS, UPS, Batteries : Types, Principle of operation. Smart Grid based on solar and wind energy systems- Electrical vehicle charging, Application of Computer in Electrical Grid, Power Tariffs.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Dr. D P Kothari, Prof I J Nagrath, “Basic Electrical Engineering” , 3rd Edition, Tata McGraw-Hill, 2009.
2. P.C. Sen, “Principles of Electrical Machines and Power Electronics”, Wiley, 2016(Reprint).

REFERENCE:

1. Joseph Edminister, Mahmood Nahvi, “Schaum's Outline of Electromagnetics” , 4th Edition, Tata McGraw-Hill, 2013
2. Vijay kumar Garg, “Basic Electrical Engineering (A complete Solution)”, Wiley Reprint 2015.

17MEC23 ENGINEERING MECHANICS FOR BIOMEDICAL ENGINEERS					
		L	T	P	C
		2	2	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE – 4**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To get exposed to the fundamental principles of mechanics	**1.1**	Solve the problems on static equilibrium of particles	**a,b**
2.0	To analyse the behaviour of the rigid body under the action of forces	**2.1**	Calculate the effect of force on rigid bodies	**a,b**
3.0	To introduce the geometric properties of the different surfaces and solids	**3.1**	Determine the centroid and moment of inertia of various surfaces and solids	**a,e**
4.0	To learn basics of fluid mechanics and relate it to bio-fluids	**4.1**	Explain the fluid properties and relate it to bio- fluids	**a,e,f**
5.0	To understand the action of motion	**5.1**	Apply the dynamic equilibrium equation and solve problems	**d,e,f**

UNIT I - BASICS AND STATICS OF PARTICLES	**(6+6)**
Units and dimensions - fundamental principles - laws of mechanics, lame‟s theorem, parallelogram and triangular law of forces, principle of transmissibility - coplanar forces - resultant force - statics of particles in two dimension - equilibrium of particles in two dimension	
UNIT II – STATICS OF RIGID BODY	**(6+6)**
Equilibrium of rigid 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 -Varignon‟s theorem - equilibrium of rigid bodies in two dimensions	
UNIT III – PROPERITIES OF SECTIONS AND SOLIDS	**(6+6)**
Introduction to rigid and deformable solids - stress-strain curve - definition and derivation of normal stress, shear stress, normal strain and shear strain - centroids - centre of mass - centroids of lines and areas - centroid or centre of gravity of simple plane figures - principal moments of inertia of plane areas - principal axes of inertia	
UNIT IV – BASICS OF MECHANICS OF FLUIDS	**(6+6)**
Fluids - density - pressure - blood pressure and gravity - buoyancy - centre of buoyancy - Newton„s laws of viscosity - Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid, Euler equations and Navier Stoke„s equations, Viscoelasticity, laminar flow, Couette flow, turbulent flow and Hagenpoiseuille equation	
UNIT V – DYNAMICS OF PARTICLES	**(6+6)**
Displacements, Velocity and acceleration, their relationship - absolute and relative motion method - linear motion - curvilinear motion - Newton‟s law - work energy equation of particles - impulse and momentum - impact of elastic bodies	
TOTAL (L:30+P:30) = 60 PERIODS	

TEXT BOOKS:

1. Vela Murali, -“Engineering Mechanics”, Oxford University Press, 2010 (Unit I, II, III, V)
2. Dr. R. K. Bansal, A Text Book of Fluid Mechanics, 1st ed., Laxmi Publications (P) Ltd., New Delhi, 2016 (Unit IV)

REFERENCES :

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2004
2. Dr. R. K. Bansal, "A Text Book of Strength of Materials", 5th ed., Laxmi Publications (P) Ltd., New Delhi, 2012
3. Frank Bell, "Principles of Mechanics and Biomechanics", Stanley Thorne (Publishers) Ltd., 1998.
4. Lee Waite, "Biofluid Mechanics in Cardiovascular Systems", The McGraw-Hill Companies, 2006.

17ITC03 - DATA STRUCTURES AND ALGORITHMS (Common to BME,EEE,ECE and E&I Branches)				
L	T	P	C	
2	0	2	3	
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To enable the student to understand the Abstract Data Types.	**1.1**	The students can Understand and apply the concept of abstract data type to represent and implement heterogeneous data structures.	**a,c,j,k**
2.0	To make the students to Learn about implementation of stack and queue.	**2.1**	The Students can Exemplify and implement how Stack ADT & Queue ADT can be implemented to manage the memory using static and dynamic allocations.	**a,c,j,k**
3.0	To enable the student to Understand the concepts of Trees.	**3.1**	The student s can Compare and contrast various techniques in Hashing and Trees.	**a,b,c,d**
4.0	To make the students to Understand the concepts of Graphs	**4.1**	The students can Understand the various types of shorting algorithms.	**a,b,c,d**
5.0	To enable the student to Understand the concepts of Sorting & Searching.	**5.1**	The students can Analyze and implement different types of sorting and searching algorithms.	**a,b,c,i**

UNIT I – INTRODUCTION	**(6)**
Data structures – Types of Data Structures - Abstract Data Type (ADT) – List ADT: Singly linked list – Doubly linked list – Circular linked list – Cursor based liked list - Applications of linked list: Addition of two polynomials – Multiplication of two polynomials.	
UNIT II – STACK AND QUEUE	**(6)**
Stack ADT – Stack model – Operations on stack – Implementation and applications. Queue ADT – Queue model – Operations on queue - Implementation and applications of Priority Queues.	
UNIT III – HASHING AND TREES	**(6)**
Introduction – Separate chaining – Open addressing - Rehashing - Extendible hashing. Binary Tree – Representation of a binary tree – Expression tree – Search tree ADT – Tree traversal – AVL tree – Single rotation – Double rotation.	
UNIT IV – GRAPHS	**(6)**
Basic terminologies – Representation of graph – Topological sort – Graph traversal - Breadth first traversal – Depth first traversal. Shortest path algorithm – Unweighted shortest path algorithm – Weighted shortest path algorithm – Minimum spanning tree – Prim‟s algorithm – Kruskal‟s algorithm.	
UNIT V – ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	**(6)**
Introduction – Insertion sort – Shell sort – Heap sort – Merge sort – Quick sort – Radix sort. External sorting – Two way merge – Multi way merge – polyphase merge. Searching – Linear search – Binary search.	
TOTAL (L:30+P:30) = 60 PERIODS	

List of Experiments:

1. Implementing Stack ADT in Python.
2. Implementing unordered list using Linked list (ADT).
3. Implementing Queue ADT in Python.
4. Implement Binary Search Tree using Python.

5. Implementation of BFS and DFS Graph Traversal using Python.

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:

Hardware:

- LAN System with 33 nodes (OR) Standalone PCs – 33 Nos,Printers – 3 Nos.

Software:

OS – Windows
Python 3.2/
Python IDE

TEXT BOOKS:

1. Mark Allen Weiss" Data structures and algorithm analysis in C" Pearson Education, 2015/PHI.

2. Dr. R. Nageswara Rao, —Core Python Programming, Dreamtech Press, 2017 Edition.

REFERENCES :

1. Michael T. Goodrich, Irvine Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", 2013edition

17ECC06 - DIGITAL LOGIC DESIGN					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC01	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make the students to understand the principles and theorems of Digital logic circuits.	**1.1**	The Students can apply the Boolean laws and theorems can able to minimize the Boolean expressions.	**a,b,f,i,k**
2.0	To enable the student to design memories and programmable logics.	**2.1**	The Students will be able to construct Programmable arrays and memory logics.	**a,c,f,j**
3.0	To enable the student to design and modeling of combinational circuits using Verilog.	**3.1**	The Students will be able to Design simple combinational logic circuits in hardware and simulation using Verilog.	**a,d,i,k**
4.0	To make the students to implement the synchronous sequential logic circuits.	**4.1**	The Students will be able to Design synchronous sequential logic circuits in hardware and simulation using Verilog.	**a,b,f,k**
5.0	To make the students to design the asynchronous sequential logic circuits.	**5.1**	The Students will be able to Design asynchronous sequential logic circuits.	**a,b,c,i,l**

UNIT I - BOOLEAN ALGEBRA AND GATE-LEVEL MINIMIZATION	**(9)**
Brief review of Digital systems, Binary numbers, Number base conversions, Complements, Binary arithmetic, Axiomatic Definition of Boolean Algebra, Basic Theorems of Boolean Algebra, Boolean Functions-Digital Logic Gates. SOP and POS- Simplification of Boolean Expressions using K-map Method and Quine- McClusky Method. Don't Care Conditions. NAND and NOR Implementations.	
UNIT II - MEMORY AND PROGRAMMABLE LOGIC FAMILIES	**(9)**
Introduction to Memory Devices-ROM, PROM, EPROM, EEPROM- Random Access Memory-Static RAM and Dynamic RAM- Programmable Logic families - Programmable Logic Array PLA, Programmable Array Logic PAL. Introduction to FPGA.	
UNIT III - DESIGN AND MODELING OF COMBINATIONAL LOGIC CIRCUITS	**(9)**
Analysis Procedure, Design Procedure, Binary Adder and Subtractor, Binary Multiplier, Code Converters, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-multiplexers, Parity generator and Checker. Hardware Description Language (HDL) - Modeling of above Combinational circuits using Verilog.	
UNIT IV – SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	**(9)**
Introduction-Storage Elements: Latches, Flip-Flops-SR, D, JK & T, Realization of FFs. Mealy and Moore Models-Design of counters-Ripple counters, Modulo-n counters, Johnson & Ring Counters. Shift Registers-SISO, SIPO, PISO, PIPO.	
UNIT V – ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	**(9)**
Introduction- Analysis and Design Procedure - State table and State diagrams, State Reduction Techniques. Design of asynchronous sequential circuits. Races and Cycles- Hazards, Design of Hazard free Circuits. Modeling of Sequential Circuits using Verilog.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. M. Morris Mano & Michael D.Ciletti, "Digital Design with an Introduction to the Verilog HDL, 5th Edition, Prentice Hall of India Pvt.Ltd. 2015.
2. Dr. Sanjay Sharma, “Digital Electronics and Logic Design” 4th Edition., S.K.Kataria & Sons, 2017.

REFERENCES :

1. Stephan D.Brown & Zvonko G.Vranesic, “Fundamentals of Digital Logic with VHDL Design, 2’nd Edition., Tata Mc Graw – Hill, 2003.
2. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis,”2’nd Edition., Prentice Hall, 2009.
3. Thomas L. Floyd & R P Jain, “Digital Fundamentals,” 10th Edition., PHI, 2011.
4. Ronald J Tocci & Neal S. Widmer, “Digital Systems, Principles and Applications,” 10th Edition., Pearson education, 2011.
5. Frank Vahid, “Digital Design with RTL Design, Verilog and VHDL,” 10’th Edition, John Wiley and Sons, 2010.

17BMC01 - ANATOMY AND HUMAN PHYSIOLOGY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17CYB05		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To identify all the organelles of an animal cell and their function.	**1.1**	Students will be able to explain basic structure and functions of cell	**a,b,f,i,k**
2.0	To understand structure and functions of the various types of systems of human body.	**2.1**	Students will be able to explain various Physiological systems	**a,c,f,j**
3.0	To demonstrate their knowledge of importance of anatomical features and physiology of human systems	**3.1**	Students will be able to learn about the functions of the various systems.	**a,d,i,k**
4.0	To familiarize the concepts of cardiac and nervous systems.	**4.1**	Students will be able to explain the internal nervous system and its function.	**a,b,f,k**
5.0	To Understand the structure and functions of digestive systems and excretory systems	**5.1**	Students will be able to analyze relation between various systems.	**a,b,c,i,l**

UNIT I - CELL AND TISSUE STRUCTURE	**(9)**
Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions	
UNIT II - SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS	**(9)**
Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. **Muscular:** Parts of Muscle – Movements. **Respiratory:** Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration	
UNIT III - CARDIOVASCULAR AND LYMPHATIC SYSTEMS	**(9)**
Cardiovascular: Components of Blood and functions.- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure. **Lymphatic:** Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels	
UNIT IV – NERVOUS AND ENDOCRINE SYSTEMS AND SENSE ORGANS	**(9)**
Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain : Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. **Endocrine** - Pituitary and thyroid gland, Sense Organs: Eye and Ear	
UNIT V – DIGESTIVE AND URINARY SYSTEMS	**(9)**
Digestive: Organs of Digestive system – Digestion and Absorption. **Urinary:** Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publsihers. 2014
2. Elaine.N. Marieb , ―Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, “Fundamentals of Anatomy and Physiology”, Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, “The Human Body – An Introduction for Biomedical and Health Sciences”, Oxford University Press, USA, 2013
3. William F.Ganong, “Review of Medical Physiology”, 22nd Edition, McGraw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, “Introduction to Human Anatomy and Physiology”, W.B. Saunders Company, 2015
5. Guyton & Hall, Medical Physiology , 13th Edition, Elsevier Saunders, 2015.

17ECP03 - DIGITAL LOGIC DESIGN LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE : 17ECP01 | **QUESTION PATTERN : TYPE -NIL**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to learn and practice the basics of logic gates	**1.1**	The Students can be able to analyze the characteristics of diodes and transistors.	**a,b,e,k**
2.0	To enable the student to design the combinational logic circuits.	**2.1**	The Students will be able to design the combinational circuits like adder, subtractor, code convertors, encoder & decoders.	**a,b,f,k**
3.0	To make the students to learn and practice with design of sequential logic circuits.	**3.1**	The Students will be able to design the sequential circuits like counters and shift registers.	**a,j,l**
4.0	To enable the students to learn about Verilog code for combinational and sequential circuits.	**4.1**	The students will be able to Implement combinational and sequential circuits using Verilog codes.	**b,d**
5.0	To motivate the students to implement the project using basic digital logics.	**5.1**	The Students will be able to design own projects based on digital logic.	**c,g**

LIST OF EXPERIMENTS:

Hardware Experiments:

1. Verification of Boolean expressions.
2. Construct a Half Adder, Full Adder using Multiplexer.
3. Construct a Code Converter circuit.(Binary to gray and BCD to XS-3)
4. Implementation of Magnitude Comparator circuit using logic gates.
5. Construct a Priority Encoder using logic gates.
6. Design adder circuit using decoders.
7. Construct a Multiplexer and De-Multiplexer circuit using logic gates.
8. Verification of SR, JK, D and T Flip Flops.
9. Design of Synchronous Counter using flip-flops.
10. Design of Shift Registers using flip-flops.

Software Experiments(Using Model Sim) :

11. Modeling and Simulation of Half adder, Full adder using Verilog.
12. Modeling and Simulation of Synchronous Counters using Verilog.

TOTAL (P: 60) = 60 PERIODS

17BMP01 – HUMAN PHYSIOLOGY LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE -NIL**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to use Microscope	**1.1**	Students will be able to handle Microscope and testing samples	**a,b,e,k**
2.0	To estimation and quantification of blood cells	**2.1**	Students will be able to analyze the structure of blood cell	**a,b,f,k**
3.0	To learnt methods for identification of blood groups	**3.1**	Students will be able to identify and enumerate blood cells	**a,j,l**
4.0	To estimation of haematological parameters	**4.1**	Students will be able to enumerate haematological parameters	**b,d**
5.0	To learnt the analysis of visual and hearing test	**5.1**	Analysis of special sensory organs test like eye and ear	**c,g**

LIST OF EXPERIMENTS:

Cycle 1:

1. General tests for carbohydrates, proteins and lipids.
2. Identification of Blood Collection Tubes and Phlebotomy equipment
3. Preparation of serum and plasma from blood.

Cycle 2:

1. Collection of Blood Samples
2. Identification of Blood groups (Forward and Reverse)
3. Bleeding and Clotting time
4. Estimation of Hemoglobin
5. Total RBC Count
6. Total WBC Count
7. Differential count of Blood cells
8. Estimation of ESR
9. PCV, MCH, MCV, MCHC
10. Hearing test – Tuning fork
11. Visual Activity – Snellen„s Chart and Jaeger„s Chart

TOTAL (P: 60) = 60 PERIODS

17GED02 – SOFT SKILLS – READING AND WRITING				
	L	T	P	C
	0	0	2	0

PREREQUISITE : NIL	QUESTION PATTERN : TYPE - NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To recollect the functional understanding of parts of speech and basic grammar.	**1.1**	The Students can be able to Apply the knowledge to identify the parts of speech and construct the sentences.	**a,b,d,l**
2.0	To acquire the reading skills through cloze texts, matching and multiple choice modes.	**2.1**	The Students can be able to Develop the reading skills through cloze texts, matching and multiple choice modes.	**a,d,e**
3.0	To enhance the writing skills for a variety of purposes.	**3.1**	The Students can be able to Interpret effectively through writing for a variety of purposes.	**a,f,k**

UNIT I – GRAMMAR	**(10)**
Articles - Adjectives - Conjunctions - Prepositions - Idioms & Phrases.	
UNIT II – READING	**(10)**
Part I : Matching 7 sentences to four short texts Part II: Text with sentences missing Part III: Text with multiple choice questions Part IV: Text with multiple choice gaps Part V: Identification of additional unnecessary words in text	
UNIT III- WRITING	**(10)**
Part I : E-mail writing, Writing short notes, Memo, Agenda & Minutes Part II: Report Writing, Complaint Letter, Writing Proposals	
TOTAL (L: 30) = 30 PERIODS	

REFERENCES:

1. Murphy, Raymond, "Essential Grammar in Use", Cambridge University Press, UK, 2007.
2. Whitby, Norman, "Business Benchmark Pre - Intermediate to Intermediate Preliminary", 2nd ed., Cambridge University Press, 2013

17MYB09 - PROBABILITY AND RANDOM PROCESSES					
		L	T	P	C
		2	2	0	3
PREREQUISITE : 17MYB02	**QUESTION PATTERN : TYPE -4**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	Enable students to understand the concepts of probability, conditional probability and independence.	**1.1**	The students will be able to understand the fundamental knowledge of the basic probability concepts.	**a,b**
2.0	Be able to obtain the distributions of functions of random variables.	**2.1**	Have a well-founded knowledge of standard distributions which can describe real life phenomena.	**a,b,c**
3.0	Understand the classifications of random processes.	**3.1**	Acquire skills in handling situations involving more than one random variable and functions of random variables.	**b,g**
4.0	Understand the concepts of as strict stationary, wide-sense stationary and Ergodic.	**4.1**	Understand and characterize phenomena which evolve with respect to time in probabilistic manner.	**a,c,g**
5.0	Understand the concepts of correlation functions and power spectral density.	**5.1**	Apply concept and properties of spectral density function and cross correlation functions.	**a,b,g**

UNIT I - PROBABILITY AND RANDOM VARIABLES	**(6+6)**
Random variable-Probability mass function – Probability density functions – Properties - Moments –Moment generating functions and their properties.	
UNIT II - STANDARD DISTRIBUTIONS	**(6+6)**
Discrete distributions: Binomial, Poisson-Continuous distributions: Uniform, Normal distributions and their properties.	
UNIT III - TWO DIMENSIONAL RANDOM VARIABLES	**(6+6)**
Joint distributions-Marginal and conditional distributions-Covariance-Correlation and Regression-Transformation of random variables-Central limit theorem (Excluding proof).	
UNIT IV - RANDOM PROCESSES	**(6+6)**
Definition and examples-first order, second order, strictly stationary, wide-sense stationary and Ergodic process-Markov process-Binomial, Poisson processes.	
UNIT V - CORRELATION AND SPECTRAL DENSITIES	**(6+6)**
Auto correlation-Cross correlation-properties-Power spectral density-Cross spectral density-properties-Wiener-Khintchine relation (Statement Only)-Relationship between cross power spectrum and cross correlation function.	
TOTAL (L: 30+T:30) = 60 PERIODS	

TEXT BOOKS:

1. Veerarajan. T, “Probability, Statistics and Random Processes,” 3rd ed., New Delhi, Tata McGraw-Hill, 2008.
2. Venkatarama Krishnan, “Probability and random Process”,2nd Edition, John Wiley &Sons, New Jersey,2016.

REFERENCES:

1. Scott L. Miller and Donald Childers, "Probability and Random Processes with applications to Signal Processing and communications," Elsevier, 2012.
2. Gubner A.John, "Probability and Random Processes for Electrical and Computer Engineers", Cambridge University press, Newyork, 2006.
3. Charles W.Therrien, Murali Tummala, "Probability and random process for electrical and computer Engineers", CRC Press, Newyork, 2012.
4. Singaravelu.A, Sivasubramanian, Ramaa, "Probability, Statistics and Random Processes," 2nd ed., Meenakshi Publication, Chennai, 2003.

17ECC07 - SIGNALS AND SYSYTEMS					
		L	T	P	C
		2	2	0	3
PREREQUISITE : 17MYB02		**QUESTION PATTERN : TYPE – 3**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the basic properties of signal & systems and its various methods of classification	**1.1**	The students will be able to Understand the operation of continuous time & Discrete time signals	**a,b,d,l**
2.0	To learn Laplace Transform &Fourier transform and their properties	**2.1**	The students will be able to Analyze the properties of signals & systems	**a,d,e**
3.0	To know Z transform and their properties	**3.1**	The students will be able to Apply Laplace transform, Fourier transform, Z transform in signal analysis	**a,f,k**
4.0	To motivate the students to implement the discrete time system using impulse response and inputs.	**4.1**	The students will be able to Implementation of continuous time LTI systems using Fourier and Laplace Transforms.	**b,f,j,k**
5.0	To characterize LTI systems in the Time domain and various Transform domains	**5.1**	The students will be able to Designing of discrete time LTI systems using Z transform	**b,f,j,l**

UNIT I - CLASSIFICATION OF SIGNALS AND SYSTEMS	**(6+6)**
Standard Signals: Unit impulse, unit step, unit ramp, exponential, and sinusoidal signals, Classification of Continuous and discrete time signals, Types of signals: power, energy, periodic, even and odd, Basic Operations on Signals, Basic System Properties: Linearity, Time Invariant, causality, stability and invertibility, LTI.	
UNIT II - TIME DOMAIN CHARACTERISATION OF CONTINUOUS TIME LTI SYSTEM	**(6+6)**
Convolution Integral, Properties of continuous time LTI system-Causality, stability, Causal continuous time LTI system described by differential equations.	
UNIT III- FREQUENCY DOMAIN REPRESENTATION IN CT SIGNALS	**(6+6)**
Fourier series representation of continuous time periodic signals, properties of continuous time Fourier series, Fourier transform of continuous time aperiodic signals and periodic signals, properties of continuous time Fourier transform, Laplace transform, Region of Covergence, Inverse Laplace transform.	
UNIT IV – TIME DOMAIN CHARACTERISATION OF DISCRETE TIME LTI SYSTEM	**(6+6)**
Sampling theorem (Low Pass) – Reconstruction of a Signal from its samples, aliasing, Convolution sum, properties of discrete time LTI system, Causal discrete time LTI system described by difference equations.	
UNIT V- FREQUENCY DOMAIN REPRESENTATION IN DT SIGNALS	**(6+6)**
Z Transform, Inverse Z transform – Long division – partial fraction, ROC, Properties of Z Transform: Linearity, time shifting, change of scale, Z-domain differentiation, differencing, accumulation, convolution in discrete time, initial and final value theorems.	
TOTAL (L: 30+T:30) = 60 PERIODS	

TEXT BOOK:

1. Alan V.Oppenheim, Alan S.Wilsky and S.Hamid Nawab, "Signals and Systems" , 2nd Edition. Prentice-Hall of India.2012.

REFERENCES :

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
4. Steven T. Karris, “Signals and Systems with MATLAB Applications”, Second Edition, Orchard Publications,2006.

17ECC11- ANALOG CIRCUIT DESIGN					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC01		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make the students to understand the circuit configurations for Linear Integrated Circuits.	**1.1**	The Students can able to understand basic concepts of Linear IC's.	**a,b,f,i,k**
2.0	To enable the student to design the basic applications of an op-amp.	**2.1**	The Students will be able to design all Linear and Non linear op-amp configurations.	**a,c,f,j**
3.0	To enable the student to design analog multiplier, PLLs and their applications.	**3.1**	The Students will be able to Design simple analog multiplier circuits and PLL applications.	**a,d,i,k**
4.0	To make the students to design A to D and D to A converters.	**4.1**	The Students will be able to Design A to D and D to A converters.	**a,b,f,k**
5.0	To make the students to design the simple circuits using timers.	**5.1**	The Students will be able to Design simple analog circuits using op-amp.	**a,b,c,i,l**

UNIT I - CIRCUIT CONFIGURATION FOR LINEAR ICS	**(9)**
Introduction-Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Ideal operational amplifier, General operational amplifier stages ,IC 741 Op-Amp, slew rate, CMRR, Open and closed loop configurations.	
UNIT II - APPLICATIONS OF OPERATIONAL AMPLIFIERS	**(9)**
Sign Changer, Scale Changer, Voltage Follower, V-to-I and I-to-V converters, Summing amplifier, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Precision Rectifier, Schmitt trigger, Low-pass, high-pass and band-pass filters.	
UNIT III - ANALOG MULTIPLIER AND PLL	**(9)**
Analog Multiplier- Applications- Squarer and frequency doubler, Gilbert Multiplier cell – Variable trans conductance technique, Operation of the basic PLL,Capture range, Lock in range and Pull in time , Application of PLL for AM detection, FM detection, FSK modulation and demodulation.	
UNIT IV - DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS	**(9)**
Introduction- D/A converter – specifications -Binary weighted resistor type, R-2R Ladder type, High speed sample-and-hold circuits, A/D Converters –specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type.	
UNIT V - WAVEFORM GENERATORS AND SPECIAL FUNCTION IC's	**(9)**
Sine-wave generators, and Triangular wave generator, Saw-tooth wave generator, CL8038 function generator, Timer IC 555- Astable and Monostable operation, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator -Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters, Video Amplifier, Opto-couplers and fibre optic IC.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Robert F. Coughlin and Driscoll, “Operational Amplifiers and Linear Integrated Circuits,”6th ed., Pearson Education. 2009.
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits” , 3’rd Edition,TMH,2007.

REFERENCES :

1. S. Salivahanan and V.S. Kanchana Bhaaskaran, “Linear Integrated Circuits”, Tata McGraw Hill (2008).
2. P. R. Gray and R. G. Meyer, “Analysis and Design of Analog Integrated Circuit,” John Wiley, 2009

17BMC02- SENSORS AND SIGNAL CONDITIONING					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make the students to understand the purpose of measurement, the methods of measurements, errors associated with measurements.	**1.1**	The Students can able to measure various electrical parameters with accuracy, precision, resolution.	**a,b,f,i,k**
2.0	To make the students to know the principle of transduction, classifications and the characteristics of different transducers	**2.1**	The Students would be able to select appropriate passive or active transducers for measurement of physical phenomenon.	**a,c,f,j**
3.0	To make the students to learn about the characteristics of transducers	**3.1**	The Students can able to choose appropriate light sensors for measurement of physical phenomenon	**a,d,i,k**
4.0	To make the students to know the different bridges for measurement.	**4.1**	The Students can able to use AC and DC bridges for relevant parameter measurement.	**a,b,f,k**
5.0	To make the students to now the different display and recording devices.	**5.1**	The Students can able to handle Multimeter, CRO and different types of recorders for appropriate measurement	**a,b,c,i,l**

UNIT I - SCIENCE OF MEASUREMENT	**(9)**
Measurement System – Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards.	
UNIT II - DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS	**(9)**
Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, Thermistor Characteristics, Active type: Thermocouple - characteristics.	
UNIT III - PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS	**(9)**
Phototube, scintillation counter, photo multiplier tube (PMT), Photovoltaic, Photo conductive cells, Photo diodes, Phototransistor, Comparison of Photoelectric Transducers. Optical Displacement Sensors and Optical Encoders. Piezoelectric Active Transducer- Equivalent circuit and its characteristics.	
UNIT IV - SIGNAL CONDITIONING CIRCUITS	**(9)**
Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering	
UNIT V - DISPLAY AND RECORDING DEVICES	**(9)**
Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

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

REFERENCES :

1. Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 6th edition, McGraw Hill, 2012.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw-Hill, New Delhi, 2014.
3. Leslie Cromwell, —Biomedical Instrumentation and Measurement, 2nd edition, Prentice Hall of India, New Delhi, 2015.
4. Albert D.Helfrick and William D. Cooper, " Modern Electronic Instrumentation and Measurement
   Techniques", Prentice Hall of India, 1st Edition, 2016.

17BMC03- BIO CONTROL SYSTEMS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make the students to understand need for mathematical modelling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems	**1.1**	The Students will be able to explain the necessity of various modeling system used in biological control systems	**a,b,f,i,k**
2.0	Analyze the time response of various systems and discuss the concept of system stability	**2.1**	The Students will be able to analyze the time response characteristics	**a,c,f,j**
3.0	Analyze the frequency response characteristics of various systems using different charts	**3.1**	The Students will be able to derive various system characteristics in frequency domain	**a,d,i,k**
4.0	Understand the concept of modeling basic physiological systems.	**4.1**	The Students will be able to explain the basic physiological system and its Models	**a,b,f,k**
5.0	Comprehend the application aspects of time and frequency response analysis in physiological control systems	**5.1**	Comprehend the application aspects of time and frequency response analysis in physiological control systems.	**a,b,c,i,l**

UNIT I – INTRODUCTION	**(9)**
Open and Closed loop Systems, Modeling and Block Diagrams, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control system	
UNIT II - TIME RESPONSE ANALYSIS	**(9)**
Step and impulse responses of first order and second order systems, time domain specifications of first and second order systems, steady state error constants, Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability.	
UNIT III - FREQUENCY RESPONSE ANALYSIS	**(9)**
Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart.	
UNIT IV - BIOLOGICAL SYSTEM MODELS	**(9)**
Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco-elastance-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems – Regulation of cardiac output, Regulation of ventilation.	
UNIT V - BIOLOGICAL CONTROL SYSTEM ANALYSIS	**(9)**
Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

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

REFERENCES:

1. Benjamin C. Kuo, “Automatic Control Systems”, Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, Second Edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, “Modern Control Systems”, Pearson, 2004.

17ITC08 - FUNDAMENTALS OF JAVA PROGRAMMING (Common To BME,ECE,EEE and E&I Branches)					
		L	T	P	C
		2	0	2	3
PREREQUISITE : 17ITC03		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To learn the fundamental concepts of Java.	**1.1**	The students will be able to learn fundamental concepts of Java.	**a,b,e**
2.0	To apply inheritance concepts using class.	**2.1**	The students will be able to design concepts with inheritance.	**a,b**
3.0	To implement exception handling and Files.	**3.1**	The students will be able to implement exception handling and Files.	**a,b,e**
4.0	To create threads and interfaces in Java classes.	**4.1**	The students will be able to create threads and interfaces in Java classes.	**a,b**
5.0	To learn GUI and generics concepts	**5.1**	The students will be able to implement GUI and generics concepts.	**a,b,e**

UNIT I INTRODUCTION	**(6+6)**
Introduction of Java - Features Of Java – Application of Java – Data Types –Statements – Operators – Control statements - Basics of Oops Concepts: Class – Objects – Methods –Constructor – finalizer –Access Control.	
UNIT II INHERITANCE AND KEYWORDS	**(6+6)**
Inheritance: Types Of Inheritance – Polymorphism – Method Overloading – Method Overriding- super – final with inheritance – Abstract Class - Keywords : static –final - this - String – String Buffer – Arrays	
UNIT III PACKAGE, EXCEPTION HANDLING AND FILES	**(6+6)**
Packages – Package Hierarchy –Basics of Exception Handling – Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files	
UNIT IV INTERFACES AND THREADS	**(6+6)**
Interfaces – Interface Design – Threads – Thread Synchronization - Multi-Thread Programming.	
UNIT V GENERICS AND GUI	**(6+6)**
Generic Programming – Generic classes – generic methods - Introduction to Swing – layout management - Swing Components – TextFields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.Applet programming - Basics of event handling - event handlers - adapter classes - actions - mouse events.	
TOTAL (L: 30+T:30) = 60 PERIODS	

List of Experiments:

1. Program to implement Operators, Flow Controls
2. Program to implement Classes, Constructors, Overloading
3. Program using Static and Final
4. Program using File Streams and IO Streams
5. Program to implement Strings, String Buffer
6. Program using Interfaces, Abstract Classes
7. Program to implement Exception Concepts and Threads
8. Program to implement Swing Application.

TEXT BOOK:

1. Herbert Schildt, “The Complete Reference (Fully updated for jdk7)”, Oracle press Ninth Edition,2014.

REFERENCES :

1. Deitel & Deitel, “Java How to Program”, Prentice Hall, 10th Edition, 2016.

17ECP06 - ANALOG CIRCUIT DESIGN LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : 17ECP01	**QUESTION PATTERN : TYPE –NIL**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to learn and practice the basic modes of operational amplifiers.	**1.1**	The Students can be able to analyze the characteristics of Inverting and Non inverting amplifiers.	**a,b,e,k**
2.0	To enable the student to design the Integrator and Differentiator circuits.	**2.1**	The Students will be able to design the Oscillator circuits and Integrator and Differentiators.	**a,b,f,k**
3.0	To make the students to learn and practice with astable and monostable multivibrators.	**3.1**	The Students will be able to design the astable and monostable multivibrator circuits using 555 timers.	**a,j,l**
4.0	To enable the students to learn about active filters.	**4.1**	The students will be able to Implement filter circuits using op-amp.	**b,d**
5.0	To motivate the students to implement the project using operational amplifiers.	**5.1**	The Students will be able to design own projects using analog IC. .	**c,g**

LIST OF EXPERIMENTS:

1. Design of Inverting and Non Inverting amplifier for a specified gain using OP-Amp IC741.
2. Design of differentiator and integrator for a specified gain using OP-Amp IC741.
3. Design of a sinusoidal oscillator for specified frequency based on Wien Bridge oscillators using IC-741.
4. Design of a sinusoidal oscillator for specified frequency based on RC phase shift oscillators using IC-741.
5. Design of Astable Multivibrators using NE555 Timer.
6. Design of Monostable Multivibrators using NE555 Timer.
7. Design and testing of Active Filter LPF for specified frequency.
8. Design and testing of Active Filter HPF for specified frequency.
9. Study of Voltage Regulator using IC723.

TOTAL (P: 60) = 60 PERIODS

17BMP02 – SENSORS AND SIGNAL CONDITIONING LABORATORY				
L	T	P	C	
0	0	4	2	

PREREQUISITE : NIL | **QUESTION PATTERN : TYPE –NIL**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to understand the characteristics of Bridge circuits and sensors.	**1.1**	The Students can be able to analyze the characteristics various bridges and its response.	**a,b,e,k**
2.0	To enable the student learn about the various measurement methods.	**2.1**	The Students would be able to understand about various measurement methods.	**a,b,f,k**
3.0	To make the students can able to demonstrate step response characteristics of Temperature transducers	**3.1**	The Students would be able to analyse the step response of the transducer	**a,j,l**
4.0	To enable the students to learn about the calibration methods	**4.1**	The students would be able to describe the necessity of calibration	**B,d**
5.0	To motivate the students to impart the knowledge in design projects.	**5.1**	The Students would be able to formulate a real world problem, identify the requirement and develop the design solutions	**c,g**

LIST OF EXPERIMENTS:

1. Displacement versus output voltage characteristics of a Potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4. Characteristic of LDR, Thermistor and thermocouple.
5. Step response characteristic of RTD and thermocouple and Study of smart transducers.
6. Wheatstone and Kelvin„s bridge for measurement of resistance.
7. Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
8. Calibration of Ammeter and Voltmeter using Student type potentiometer.
9. Design, Construction and calibration of series and shunt type ohmmeters.
10. Torque measurement
11. Vacuum pressure measurement

TOTAL (P: 60) = 60 PERIODS

17GED01 - SOFT SKILLS-LISTENING AND SPEAKING				
	L	T	P	C
	0	0	2	0
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE – NIL**			

COURSE OBJECTIVES AND OUTCOMES:

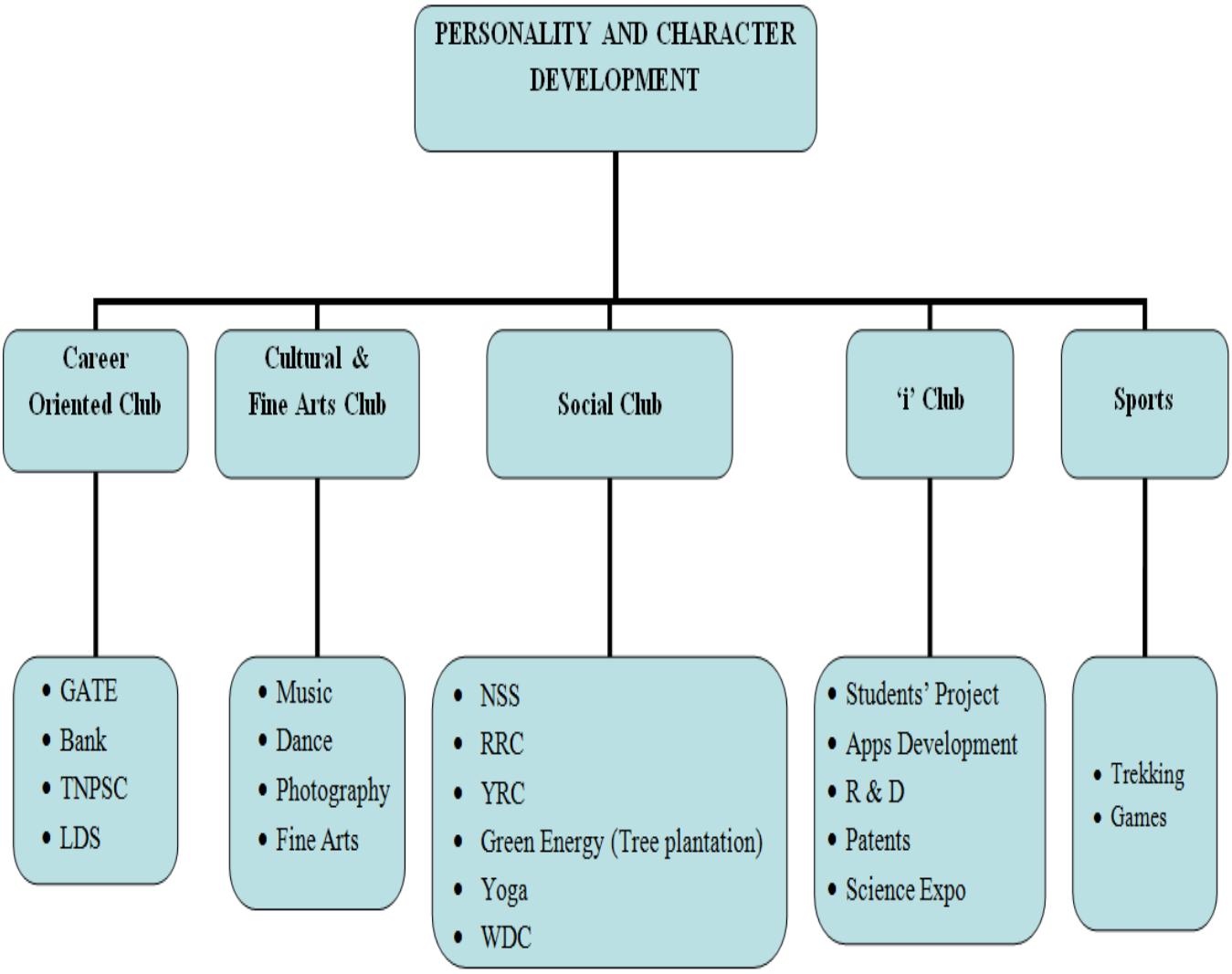
Course Objectives		Course Outcomes		Related Program outcomes
1.0	To recollect the functional understanding of basic grammar and its structure.	**1.1**	Apply the knowledge of basic grammar to classify the types of verbs and questions and to construct the sentences.	**i,k,l**
2.0	To acquire the listening skills through note completion, matching and multiple choice modes.	**2.1**	Develop the listening skills through note completion, matching and multiple choice modes.	**i,k,l**
3.0	To develop speaking skills through self introduction, short talk and topic discussion.	**3.1**	Organize a presentation on the given topic.	**i,k,l**

UNIT I – GRAMMAR	**(10)**
Tenses - Verb (Auxiliary and Modal) - 'Yes/No' Type Questions - Reported Speech - Gerund - Phrasal Verbs	
UNIT II – LISTENING	**(10)**
Part I : Note completion Part II: Matching Part III: Multiple Choice	
UNIT III- SPEAKING	**(10)**
Part I : Self Introduction Part II: Short talk on business topics Part III: Discussion in pairs	
TOTAL (L: 30) = 30 PERIODS	

REFERENCES:

1. Murphy, Raymond, "Essential Grammar in Use", Cambridge University Press, UK, 2007
2. Whitby, Norman ,"Business Benchmark Pre- Intermediate to Intermediate Preliminary, 2nd ed., Cambridge University Press, 2013.

17GED03 - PERSONALITY AND CHARACTER DEVELOPMENT				
	L	T	P	C
	0	0	1	0



***LDS - Leadership Development Skills**

OBJECTIVES :				
Career Oriented Club	**Cultural & Fine Arts Club**	**Social Club**	**'i' club**	**Sports**
• To provide support for identifying specific career field of interests and career path • To provide support for preparing for competitive exams	• To bring out the hidden talent of students in music, dance and other fine arts. • To promote photography skill among the students • To develop and enhance the performance of students by participating in various events • To inculcate managerial capabilities such as event management and stage organization	• To create social awareness and develop a sense of social and civic responsibility • To inculcate socially and environmentally sound practices and be aware of the benefits • To encourage the students to work along with the people in rural areas, thereby developing their character, social consciousness, commitment, discipline and being helpful towards the community.	• To inculcate the basic concepts of innovation • To foster the networking between students, build teams, exchange ideas, do projects and discuss entrepreneurial opportunities • To enrich the academic experience, build competencies and relationships beyond the classroom	• To provide opportunities to excel at sports • To promote an understanding of physical and mental well-being through an appreciation of stress, rest and relaxation. • To develop an ability to observe, analyze and judge the performance of self and peers in sporting activities. • To develop leadership skills and nurture the team building qualities. **Trekking:** • To provide opportunities to explore nature and educating about the purity of nature • To improve physical and mental health.

OUTCOMES : At the end of this course, the students will be able to				
• Find a better career of their interest. • Make use of their knowledge during competitive exams and interviews.	• Take part in various events • Develop team spirit, leadership and managerial qualities	• Develop socially responsive qualities by applying acquired knowledge • Build character, social consciousness, commitment and discipline	• Apply the acquired knowledge in creating better solutions that meet new requirements and market needs • Develop skills on transforming new knowledge or new technology into viable products and services on commercial markets as a team	• Demonstrate positive leadership skills that contribute to the organizational effectiveness • Take part an active role in their personal wellness (emotional, physical, and spiritual) that supports a healthy lifestyle • Create inclination towards outdoor activity like nature study and Adventure.

TOTAL [2 x (P: 15)]: 30 PERIODS

(Cumulatively for Two Semesters)

17CYB03 ENVIRONMENTAL SCIENCE *(Common to All Branches)*					
			L	T	P	C
			3	0	0	3
PREREQUISITE: NIL		**QUESTION PATTERN : TYPE – 3**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To understand the constitutes of the environment.	**1.1**	Design a system, component, or process to meet desired needs.		**c, g**
2.0	The students should be conversant with valuable resources	**2.1**	Identify, formulate, and solve environmental engineering problems		**a, c, g**
3.0	To know about the role of a human being in maintaining a clean environment.	**3.1**	Understand the professional and ethical responsibility as related to the practice of environmental engineering and the impact of engineering solutions in a global context.		**c, f, g**
4.0	To maintain ecological balance and preserve bio-diversity.	**4.1**	Use the techniques, skills, and modern engineering tools necessary for environmental engineering practice.		**a, c**
5.0	To get knowledge about the conservation of environment for the future generation.	**5.1**	Acquire the knowledge of information technology in environmental science.		**a, f, g**

UNIT I : INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES	**(9)**
Environment: Scope – importance - need for public awareness - Forest resources - Use-over exploitation-deforestation - Water resources - use-over utilization of surface and ground water - conflicts over water - Mineral resources - use-exploitation-environmental effects of extracting and using mineral resources - Food resources - world food problems changes caused by agriculture - Effects of modern agriculture - fertilizer- pesticide problems - Energy resources - Renewable energy sources - solar energy - wind energy. Land resources - land degradation - soil erosion - Role of an individual in conservation of natural resources.	
UNIT- II ECOSYSTEMS AND BIODIVERSITY	**(9)**
Concepts of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Food chains- food webs - types of ecosystem - structure and functions of forest ecosystem and river ecosystem – Biodiversity - value of biodiversity - consumptive use-productive use - social values - ethical values - aesthetic values - Hotspots of biodiversity -Threats to biodiversity - Habitat loss - poaching of wildlife and man wildlife conflicts- Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.	
UNIT III : ENVIRONMENTAL POLLUTION	**(9)**
Pollution: Causes - effects and control measures of Air pollution - Water pollution - Soil pollution and Noise pollution - Solid waste management - Causes - effects -control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster managements - Floods - cyclone- landslides.	
UNIT IV : SOCIAL ISSUES AND THE ENVIRONMENT	**(9)**
Water conservation - rain water harvesting - global warming - acid rain - ozone layer depletion - Environment protection act - Air (Prevention and control of pollution) Act - Water (prevention and control of pollution) Act - Green Chemistry – Principle of Green chemistry – Application of Green chemistry.	

UNIT V : HUMAN POPULATION AND THE ENVIRONMENT	(9)
Population growth - variation among nations - Population explosion - Family welfare programme - Human rights - HIV/AIDS – Human health and environment - women and child welfare - Role of information technology in environment and human health.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International Publishers, New Delhi (2015).
2. Dr. A.Ravikrishan, Envrionmental Science and Engineering., Sri Krishna Hitech Publishing co. Pvt. Ltd., Chennai,12th Edition (2016).

REFERENCES:

1. Masters, Gilbert M, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education, New Delhi (2012).
2. Santosh Kumar Garg, Rajeshwari garg, smf Ranjni Garg "Ecological and Environmental Studies" Khanna Publishers, Nai Sarak, Delhi (2014).
3. Miller T.G. Jr., "Environmental Science", Tenth Edition, Wadsworth Publishing Co. (2015).

17GEA02 – PRINCIPLES OF MANAGEMENT					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE – 3**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To study the importance and functions of management in an organization.	**1.1**	The Students will acquire comprehensive knowledge on management concepts.	**g, h, i**
2.0	To study the importance of planning and also the different types of plan.	**2.1**	The Students will be able to understand and apply planning concepts at different conditions and situations.	**c, d, g, i**
3.0	To understand the different types of organization structure in management	**3.1**	The Students will accomplish organizational structures and understand the staffing process.	**c. d, f, i**
4.0	To understand the basis and importance of directing in management	**4.1**	The Students will be able to employee's motivation and project managements in working environments.	**d, f, j, k**
5.0	To understand the importance of control techniques	**5.1**	The Students will be able to do the budgetary and non-budgetary control of projects.	**c, e, g, k**

UNIT I - OVERVIEW OF MANAGEMENT	**(9)**
Definition of management – Science & Art – Management & Administration - Role of managers – Evolution of Management thoughts – Contribution of Taylor and Fayol – Functions of management – Strategies for International business.	
UNIT II – PLANNING	**(9)**
Nature and purpose of planning - Planning process - Types of plans – Objectives – Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.	
UNIT III – ORGANIZING	**(9)**
Nature and purpose of organizing - Organization structure - Formal and informal organization - Line and Staff authority- Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing – Selection and Recruitment - Orientation -Career Development - Career stages – Training - Performance Appraisal.	
UNIT IV – DIRECTING	**(9)**
Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership – Types of Leadership – Job enrichment - Communication - hurdles to effective communication – Organization Culture - Elements and types of culture - Managing cultural diversity.	
UNIT V – CONTROLLING	**(9)**
System and Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control – Quality Control - Planning operations .balance sheet understanding.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Harold Koontz, Heinz Weihrich , “Essentials of Management”, Tata McGrawHill, 8th edition Second Reprint 2010.

REFERENCES:

1. Andrew J. Dubrin, “Essentials of Management”, Thomson Southwestern, 9th ed., 2012.
2. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall of India, 10th Edition, 2010.
3. Charles W L Hill, Steven L Mc Shane, “Principles of Management”, Mc Graw Hill Education, Special Indian Edition, 2008.
4. Hellriegel, Slocum & Jackson, “Management - A Competency Based Approach”, Thomson South Western, 10th edition, 2007.
5. Harold Koontz, Heinz Weihrich and Mark V Cannice, “Management - A global & Entrepreneurial Perspective”, Tata Mc Graw Hill, 12th ed., 2007.

17ECC16 - ANALOG AND DIGITAL COMMUNICATION					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC06	**QUESTION PATTERN : TYPE – 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide knowledge on complete analysis of Analog communications.	**1.1**	The students will be able to acquire the knowledge about Analog modulation and demodulation schemes	**a,c,d,i**
2.0	To acquire knowledge about Pulse modulation.	**2.1**	The students will be able to acquire the knowledge about Pulse modulation and demodulation schemes	**b,l,f,j**
3.0	To learn the concepts of noise theory and basics of error control coding.	**3.1**	The students will be able to calculate SNR of various communication systems and perform error control coding.	**a,d,i**
4.0	To analyze the performance of Baseband Transmission.	**4.1**	The students will be able to analyze the methods of baseband data transmission and reception.	**b,c,j,k,**
5.0	To analyze the performance of Pass band Transmission.	**5.1**	The students will be able to analyze the performance of various Pass band data transmission and reception techniques.	**a,e,f**

UNIT I - ANALOG MODULATION SCHEMES	**(9)**
Functional block diagram of communication systems- Linear modulation schemes: Generation of AM: DSBFC using balanced modulator- Introduction to DSBSC, SSBSC and VSB Signals-Comparison of Amplitude Modulation Systems. Principle of frequency and phase modulation– Relation between FM and PM waves–Frequency modulation: Narrowband and wide band FM-Transmission bandwidth of FM.	
UNIT II - PULSE MODULATION SYSTEMS	**(9)**
Pulse amplitude modulation–generation and detection of PWM and PPM-Basic signal processing operations in Digital Communications–Sampling theorem-Quantization: Uniform and Non-uniform (A-law & μ-law) - Pulse code modulation, Differential pulse code modulation, Delta Modulation, Adaptive Delta modulation -Classification of line coding and Decoding.	
UNIT-III - NOISE THEORY AND CODING TECHNIQUES	**(9)**
Types of noise in communication systems, Noise temperature. Noise in CW modulation systems- signal to noise ratio (SNR), noise figure, noise in AM –SSB & FM receivers, pre-emphasis and de-emphasis. Coding Techniques : Shannon- Fano coding, Linear Block Codes.	
UNIT IV - BASEBAND DATA TRANSMISSION AND RECEPTION	**(9)**
Matched Filter –Error rate due to noise –Inter symbol Interference- Nyquist criterion for distortion less base band Binary Transmission-Correlative level coding: Duo binary with and without precoder- Modified duo binary with and without precoder –Eye patterns.	
UNIT V- PASSBAND DATA TRANSMISSION AND RECEPTION	**(9)**
Pass band Transmission model-Generation, detection ,signal space diagram, bit error probability and power spectra of Binary Modulation schemes (ASK,FSK,PSK), Quadrature Modulation schemes (QPSK,QAM) – Comparison of Binary and Quadrature modulation techniques.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Simon Haykin, "Communications Systems", Wiley Education, 4th Edition, 2008
2. T L Singal, "Analog & Digital Communications", Tata McGraw-Hill Education, 4th Edition, 2012

REFERENCES :

1. Taub and Schilling, "Principles of Communication Systems", McGraw Hill, 3rd Edition, 2007.
2. Wayne Tomasi, "Electronic Communications Systems–Fundamentals Through advanced", Pearson Education, 4th Edition, 2007.
3. Praokis J.G., "Digital Communications" 4th Edition, McGraw Hill, 2000.
4. Bernard Sklar, Pabitra Kumar Ray "Digital Communications: Fundamentals & Applications", Pearson Education, 2nd Edition, 2009.

17BMC04 –BIOSIGNAL PROCESSING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC07		**QUESTION PATTERN : TYPE – 3**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To learn Discrete Fourier transforms and Fast Fourier Transform and its properties.	**1.1**	The students can apply DFT and FFT for the analysis of biomedical signals.	**a,b,d,f,g,j**
2.0	To know the characteristics and design of FIR and IIR filters..	**2.1**	The students will be able to design and implement digital filters in the field of biomedical signal analysis.	**a,b,c,d,f,g,j**
3.0	To characterize various biomedical signals and its interference in time domain and frequency domain.	**3.1**	The students will be able to distinguish various biomedical signals and methods to remove the artifacts	**a,b,c,d,f,g,j**
4.0	To understand the event detection in ECG and EEG signal.	**4.1**	The students will be able to identify the events in ECG and EEG signal	**a,c,d,g**
5.0	To learn about various Wavelets and its functions	**5.1**	The students will be able to apply the Wavelet concepts for various biomedical signals.	**c,g**

UNIT I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING	**(9)**
Review of sampling and reconstruction, discrete-time signals & systems. DFT and its properties – Fast Convolution: Overlap-add & overlap-save methods. FFT algorithms & its application. Introduction to random process-definition, methods of description, stationarity, time averaging and ergodicity.	
UNIT II : FILTER DESIGN	**(9)**
Digital Processing of Continuous Time Signals, Analog Filter Design-Analog butterworth, Chebyshev LPF Design, Transformations -Analog frequency Transformation, Digital Filter Structures-IIR Realizations, All Pass Realizations, IIR Filter Design- IIR Design by Impulse Invariant - Bilinear Transformation, Digital to Digital Frequency Transformation, FIR Filter Design-FIR Design by Windowing. (Rectangular, Hamming, Hanning and Blackman)	
UNIT III: BIOMEDICAL SIGNALS &ARTIFACT REMOVAL	**(9)**
Nature of biomedical signals, characteristics of various bio-signals: interference associated with each bio-signal, computer aided diagnosis. Time domain filtering: synchronous averaging, moving average filters, derivative based ,frequency domain filtering-FIR,IIR –notch, comb - optimal filtering - adaptive filtering using LMS algorithm-applications.	
UNIT IV :POWER SPECTRUM ESTIMATION AND EVENT DETECTON	**(9)**
Introduction – Non parametric methods - The Periodogram – Modified Periodogram - Bartlett, Welch & Blackman - Tukey methods - Performance comparison. Event detection- ECG, correlation analysis of EEG channels, Homomorphic filtering.	
UNIT V :INTRODUCTION TO WAVELET TRANSFORM	**(9)**
Short comings of STFT, Need for wavelets, Wavelet Basis-Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Vinay K. Ingle, John G. Proakis , “Digital Signal Processing Using MATLAB”, Cengage Learning , 2012
2. Rangaraj M Rangayyan, “Biomedical Signal Analysis”, Wiley, 2015.

REFERENCES:

1. Amine Nait-Ali, “Advanced Bio signal processing”, Springer, 2009.
2. Robert B Northrop, “Signals and Systems Analysis in Biomedical Engineering”, 2nd ed., CRC Press, New York, 2016.
3. Gail D Baura, “System Theory and Practical Applications of Biomedical Signals”, Dreamtech Press, Newyork, 2002.
4. Ifeachor E C and Jervis B. W, “Digital Signal Processing: A Practical Approach”, Prentice Hall, 2009.
5. Gérard Blanchet, Maurice Charbit, “Digital Signal and Image Processing Using MATLAB”, ISTE, United States, 2006.
6. Soman K P and Ramachandran K I, “Insight into Wavelets from Theory to Practice”, Prentice Hall India, 2010.

17BMC05 – BIOMEDICAL INSTRUMENTATION-I					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17BMC02		**QUESTION PATTERN : TYPE – 1**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To Illustrate origin of bio potentials and its propagations	**1.1**	The students will differentiate different bio potentials and its propagations.	**a,b,c,d**	
2.0	To understand the different types of electrodes and its placement for various recordings	**2.1**	The students can Illustrate different electrode placement for various physiological recordings	**b,c,e,g**	
3.0	To design bio amplifier for various physiological recordings.	**3.1**	The students can design bio amplifier for various physiological recordings	**a,c,e,h**	
4.0	To learn the different measurement techniques for non-physiological parameters.	**4.1**	The students can explain various technique for non-electrical physiogical measurements	**c,e,f,g**	
5.0	To Summarize different biochemical measurements.	**5.1**	The students can demonstrate different biochemical measurement techniques.	**b,c,f,g**	

UNIT I:BIOPOTENTIAL ELECTRODES	**(9)**
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.	
UNIT II : BIOPOTENTIAL MEASUREMENTS	**(9)**
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven„s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of EGG.	
UNIT III: SIGNAL CONDITIONING CIRCUITS	**(9)**
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.	
UNIT IV :MEASUREMENT OF NON-ELECTRICAL PARAMETERS	**(9)**
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.	
UNIT V :BIOCHEMICAL MEASUREMENT AND BIOSENSORS	**(9)**
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and voltometric techniques.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation, 3rd ed., Tata McGraw-Hill New Delhi, 2014.
2. Leslie Cromwell, "Biomedical Instrumentation and measurements", 2nd ed., Prentice hall of India, New Delhi, 2015.

REFERENCES:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th ed., Wiley India Pvt Ltd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.

17BMP03 –BIOSIGNAL PROCESSING LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE –NIL**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	The student should be made to generate various biomedical signals.	**1.1**	The students will be able to analysis various biomedical signals.	**a,b,f,i,l**	
2.0	The student able to implement FIR and IIR filters for biomedical signals.	**2.1**	The students will be able to able to design FIR and IIR filters for biomedical signals.	**a,b,f,l**	
3.0	The student able to implement the concepts of Butterworth and Chebyshev filter.	**3.1**	The students will be able to design the concepts of Butterworth and Chebyshev filter.	**a,b,f**	
4.0	The student able to understand the concepts of event detection in ECG and EEG.	**4.1**	The student able to identify the concepts of event detection in ECG and EEG.	**a,d,k,l**	
5.0	The student able to learn the concepts of wavelet.	**5.1**	The student able to apply the concepts of wavelet.	**c,i,k**	

LIST OF EXPERIMENTS:

1. Representation of Basic Signals (Sine, Cosine, Unit impulse ,Unit Step, Square, Exponential, Sawtooth)
2. Verification of sampling theorem.
3. Introduction of various Biomedical Signals (ECG, EEG, EMG, EOG)
4. DFT and FFT computation of ECG, EEG, EMG and EOG
5. IIR filters design-digital Butterworth filter for EEG signal
6. IIR filters design-digital Chebyshev filter for ECG signal
7. FIR Filter Design Using Windowing Technique for EEG signal
8. Power Spectrum Estimation
9. Temporal And Synchronous Averaging
10. Adaptive filtering using LMS algorithm
11. Event Detection: QRS in ECG, alpha activity in EEG
12. Homomorphic Filtering for ECG and EEG
13. EMG feature extraction
14. Signal denoising using wavelet

TOTAL (P: 60) = 60 PERIODS

17BMP04 – BIOMEDICAL INSTRUMENTATION-I LABORATORY				
L	T	P	C	
0	0	4	2	
PREREQUISITE : 17BMP02	**QUESTION PATTERN : TYPE -NIL**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To design preamplifiers and amplifiers for various bio signal recordings.	**1.1**	The students will able to design preamplifiers and amplifiers for various bio signal recordings.	**a,b,c,e**
2.0	To provide hands-on training on Measurement of physiological parameters.	**2.1**	The students will able to measure physiological parameters.	**b,d,e,g**
3.0	To provide hands-on training on biochemical parameters.	**3.1**	The students can analyze biochemical parameters.	**a,e,h,k**
4.0	To provide hands-on training on designing of bio signal acquisition system.	**4.1**	The students can design PCB layout for any bio amplifier.	**b,c,d,h**
5.0	To Measure various non-electrical parameters using suitable sensors/transducers.	**5.1**	The students can able to Measure various non-electrical parameters using suitable sensors/transducers.	**a,b,c,e,l**

LIST OF EXPERIMENTS:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC„s
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design of EOG amplifier to detect eye blink
7. Design and study the characteristics of optical Isolation amplifier
8. Design a Multiplexer and Demultiplexer for any two bio signals.
9. Measurement of pulse-rate using Photo transducer.
10. Measurement of pH and conductivity.
11. Measurement of blood pressure using Sphygmomanometer.
12. Measurement and recording of peripheral blood flow
13. Design a PCB layout for any bio amplifier using suitable software tool.
14. Study on SPO2.

TOTAL (P: 60) = 60 PERIODS

17GED07- CONSTITUTION OF INDIA					
		L	T	P	C
		2	0	0	0
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To educate about the Constitutional Law of India	**1.1**	The students will be able to Gain Knowledge about the Constitutional Law	**f, h, l**	
2.0	To motivate students to Understand the Fundamental Rights and Duties of a citizen	**2.1**	The students will be able to Understand the Fundamental Rights and Duties of a citizen	**f, g, h**	
3.0	To make students to understand about Federal structure of Indian Government	**3.1**	The students will be able to Apply the concept of Federal structure of Indian Government	**f, g, h**	
4.0	To understand about Amendments and Emergency provisions in the Constitution	**4.1**	The students will be able to Analyze the Amendments and Emergency provisions in the Constitution	**f, g, h**	
5.0	To educate a holistic approach in their life as a Citizen of India	**5.1**	The students will be able develop a holistic approach in their life as a Citizen of India	**f, h, l**	

UNIT I - Introduction to Indian Constitution	**(6)**
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India	
UNIT II - Fundamental Rights	**(6)**
Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - 102 Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation	
UNIT III - Federal Structure	**(6)**
Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India	
UNIT IV - Amendment to Constitution	**(6)**
Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India	
UNIT V - Emergency Provisions	**(6)**
National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India	
TOTAL = 30 PERIODS	

REFERENCES:

1. Constitution of India - Ministry of Law & Justice – PDF format awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by Durgadas Basu
3. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html

17ECC13 - MICROPROCESSOR AND MICROCONTROLLER INTERFACING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC06		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	Understand the concepts of internal architecture of Microprocessor and Microcontroller.	**1.1**	The students will be able to apply the basic concepts of peripherals and develop the real time applications	**a,c,d,k**
2.0	Understand the concepts of assembly language programming	**2.1**	The students will be able to program Microprocessor and Microcontroller for different applications using assembly language programming.	**b,c,k**
3.0	Understand the concepts of high level language programming	**3.1**	The students will be able to develop Microcontroller based system using higher level language	**b,c,e,k**
4.0	Illustrate how the different peripherals are interfaced with microcontroller.	**4.1**	The students will be able to design and develop real time applications using Microcontrollers	**b,c,d,k**
5.0	Familiar with the concepts of RISC based Microcontroller architecture	**5.1**	The students will be able to acquire knowledge about peripherals and develop the real time applications	**a,c,d,k**

UNIT I – 8 BIT MICROPROCESSOR & MICROCONTROLLER	**(9)**
Origin and classification of Microprocessor - 8085 Architecture- 8051 Microcontroller: Architecture – Signals – Memory Organization - Interrupts – Timer/counter -Serial communication.	
UNIT II – 8051 ASSEMBLY LANGUAGE PROGRAMMING	**(9)**
8051 Addressing mode – Instruction Set – Programming 8051 Timers – Serial Port programming – Interrupt Programming.	
UNIT III- 8051 HIGH LEVEL LANGUAGE PROGRAMMING	**(9)**
Data types and time delay in 8051 C – I/O Programming in 8051 C – Logical operations in 8051 C – Accessing code ROM space in 8051 C – Timer programming in C – Serial port programming in C – Interrupt programming in C	
UNIT IV - 8051 EXTERNAL INTERFACING	**(9)**
LCD & Keyboard Interfacing - ADC, DAC & LM35 Temperature Sensor Interfacing - External Memory Interface- Stepper Motor Interfacing	
UNIT V- PIC MICROCONTROLLER	**(9)**
PIC 16F877 Microcontroller Architecture - Memory organization -Interrupts Timer/Counter - Compare/Capture/PWM modules (CCP) - Master Synchronous Serial Port module (MSSP).	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011
2. John B Peatman, “Design with PIC Microcontrollers”, Pearson Education Asia, 2013, Twenty third Impression.

REFERENCES :

1. Ramesh S. Goankar, “Microprocessor Architecture: Programming and Applications with the8085", Sixth edition, Penram International, 2015 Reprint
2. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw – Hill, 2012, Twentieth Reprint.
3. Senthilkumar, Saravanan, Jeevanantham, Shan “Microprocessor & Interfacing”, Oxford University press, 2012.
4. K.Uma Rao. Andhe Pallavi, “The 8051 Microcontroller Architecture, Programming and Applications” Pearson Education 2011, Second Impression.

17BMC06 - MEDICAL IMAGE PROCESSING					
		L	T	P	C
		2	0	2	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To impart the fundamental concepts of Digital Image.	**1.1**	The students will be able to understand the basics of Digital Image and acquiring of Medical Images.	**a,b,i,j,l**
2.0	To characterize the medical images by filtering techniques	**2.1**	The students will be able to distinguish the enhancement techniques in spatial and frequency domain	**a,b,c,f,j**
3.0	To learn the concepts of image Compression and reconstruction techniques	**3.1**	The students will be able to apply the knowledge of compression standards in real time image transmission	**a,b,d,k,l**
4.0	To become familiar with Segmentation concepts and techniques	**4.1**	The students will be able to choose the most appropriate technique for a particular image	**a,b,c,d,k**
5.0	To know the complexity and problems associated with imaging tasks	**5.1**	The students will be able to select potential strategies for analysing images from a variety of applications	**a,b,i,j,l**

UNIT I - IMAGING SYSTEMS	**(9)**
Imaging systems , Objects and images, The digital image processing system, Applications of digital image processing, The human visual pathway ,Photographic film, Other sensors, Digitizing an image, The quality of a digital image, Color images, Medical images obtained with ionizing radiation and non-ionizing radiation.	
UNIT II - IMAGE ENHANCEMENT AND REGISTRATION	**(9)**
Spatial domain Enhancement: Gray-level histogram, Histogram transformations and look-up tables, Histogram Calculation of MRI image. Spatial Domain Filters: Smoothing and Sharpening, Frequency Domain Enhancement: Smoothing - Sharpening filters -Homomorphic filters. Image Degradation Model, Noise-reduction filters- Adaptive filters, Blurring-Deblurring, Wiener filters, Application of filters on Axial Brain MRI.	
UNIT – III : IMAGE COMPRESSION AND RECONSTRUCTION	**(9)**
Role of compression is in the medical field, Generic Compression method, JPEG standard, JPEG 2000 Standard for Angiography, Standards in Medical Image Compression – DICOM standard, Health Level Seven (HL7).	
UNIT – IV: THRESHOLDING AND SEGMENTATION	**(9)**
Thresholding, Region-based methods, Boundary-based methods-Edge detection and linking-Boundary tracking, Active contours, Watershed segmentation, Application of thersholding concepts on Retinal image.	
UNIT – V : MEDICAL APPLICATIONS OF IMAGING	**(9)**
Computer-aided diagnosis in mammography, Tumor imaging and treatment, Angiography, Bone strength and osteoporosis, Tortuosity, Image Processing in medicine.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Geoff Dougherty, “Digital Image Processing for Medical Applications”, Cambridge University PRESS, 2009.
2. Amine Nait-Ali (Editor), Christine Cavaro-Menard (Editor), “Compression of Biomedical Images and Signals”,

ISBN: 978-1-118-62380-0, March 2013 Wiley-ISTE.

REFERENCES :

1. Rafael C. Gonzalez, Richard E.Woods, Richard Eugene Woods, Steven L. Eddins, “Digital Image processing using MATLAB”, Pearson Prentice Hall, 2004
2. A K Jain, “Fundamental of Digital Image Processing”, Prentice Hall, 2002.
3. Jayaram, Kudupa and Gabor,T Herman, “3D imaging in medicine”, 2nd ed., CRC press, 2000.
4. Rangaraj M. Rangayyan, “Biomedical Image Analysis”, CRC Press, 2004.
5. Sid-Ahmed Maher A, “Image Processing Theory, Algorithms and Architecture”, McGraw Hill, 1994.

17BMC07 – BIOMEDICAL INSTRUMENTATION-II					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17BMC05	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the devices for measurement of parameters related to cardiology.	**1.1**	The students will able to describe the working and recording setup of all basic cardiac equipment.	**a,b,c,d**
2.0	To Illustrate the recording and measurement of EEG	**2.1**	The students will able to understand the working and recording of all basic neurological equipments.	**b,c,e,g**
3.0	To Demonstrate EMG recording unit and its uses.	**3.1**	The students can discuss the recording Of diagnostic and therapeutic equipments related to EMG.	**a,c,e,h**
4.0	To explain diagnostic and therapeutic devices related to respiratory parameters.	**4.1**	The students can explain about measurements of parameters related to respiratory system.	**c,e,f,g**
5.0	To understand the various sensory Measurements that hold clinical importance.	**5.1**	The students can able to describe the measurement techniques of sensory responses.	**b,c,f,g,l**

UNIT I: CARDIAC EQUIPMENT	**(9)**
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter. Clinical applications	
UNIT II : NEUROLOGICAL EQUIPMENT	**(9)**
Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.Clinical applications.	
UNIT III: MUSCULAR AND BIOMECHANICAL MEASUREMENTS	**(9)**
Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.	
UNIT IV :RESPIRATORY MEASUREMENT SYSTEM	**(9)**
Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.	
UNIT V :SENSORY MEASUREMENT	**(9)**
Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and DesignII", 4th ed., Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technolog", Pearson education, 2012.

REFERENCES :

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd ed., 2008
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
4. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
5. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, "Medical Physics and Biomedical Engineering", 2nd ed., IOP Publishers. 2001.

17ECP08 - MICROPROCESSOR AND MICROCONTROLLER INTERFACING LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : 17ECP03		**QUESTION PATTERN : TYPE -NIL**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To make students to learn and practice the basics of 8085 programming concepts	**1.1**	The students will be able to develop applications using 8085 processor program.		**a,b,i**
2.0	To enable the student to analyze the various arithmetic & Logical operations in 8085 processor.	**2.1**	The students will be able to evaluate various arithmetic & Logical operations using 8085 processor.		**b,c,d,k**
3.0	To provide the student with practice in the 8051 microcontroller.	**3.1**	The students will be able to verify the various arithmetic & Logical operations using 8051 controller.		**b,c,d,k**
4.0	To make the students to learn and practice with 8051 peripherals	**4.1**	The Students will be able to verify the basic peripherals in 8051 using HLP.		**c,d,e,k**
5.0	To motivate the students to learn the I/O interfacing concepts in 8051.	**5.1**	The Students will be able to implement the interfacing concepts for various real world applications.		**d,e,f,k**

LIST OF EXPERIMENTS:

Assembly Language Programming:

1. Study of 8085 microprocessor (Addressing modes & Instruction set).
2. Assembly language programming for 8/16 bit Arithmetic operators Using 8085.
3. Assembly language programming with control instructions Using 8085 (Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers.
4. Assembly language programming for arithmetic and logical operations using 8051.
5. Interfacing and Programming of DC Motor Speed control using 8051.
6. Interfacing and Programming of Stepper Motor control using 8051.

High Level Language Programming

The following programs have to be tested on 8051 Development board/equivalenting Embedded C Language on KEIL IDE or Equivalent.

1. Program to toggle all the bits of Port P1 continuously with delay.
2. Program to toggle P1.5 continuously with delay. Use Timer in mode 0, mode 1, mode 2 and mode 3 to create delay using 8051.
3. Program to interface 7 segment display to display a message on it using 8051.
4. Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD using 8051.
5. Program to get analog input from Temperature sensor and display the temperature Value on LCD using ADC with 8051 Microcontroller.
6. Program to handle interrupts with 8051 Microcontroller.

TOTAL (P: 60) = 60 PERIODS

17BMP05 – BIOMEDICAL INSTRUMENTATION-II LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : 17BMP04					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To demonstrate recording and analysis of different Bio potentials.	**1.1**	The students will able to Measure different bioelectrical signals using various methods.	**a,b,c,e**	
2.0	To Assess different non-electrical parameters using various methodologies	**2.1**	The students will able to Assess different non- electrical parameters using various methodologies	**b,d,e,g**	
3.0	To Illustrate various diagnostic and therapeutic techniques.	**3.1**	The students can Illustrate various diagnostic and therapeutic techniques.	**a,e,h,k**	
4.0	To examine the electrical safety measurements.	**4.1**	The students can Examine the electrical safety measurements.	**b,c,d,h**	
5.0	To analyze the different bio signals using suitable tools.	**5.1**	The students can able to Analyze the different bio signals using suitable tools.	**a,b,c,e,l**	

LIST OF EXPERIMENTS:

1. Measurement of visually evoked potential
2. Galvanic skin resistance (GSR) measurement
3. Study of shortwave and ultrasonic diathermy
4. Measurement of various physiological signals using biotelemetry
5. Study of hemodialysis model
6. Electrical safety measurements
7. Measurement of Respiratory parameters using spirometry.
8. Study of medical stimulator
9. Analyze the working of ESU – cutting and coagulation modes
10. Recording of Audiogram
11. Study the working of Defibrillator and pacemakers
12. Analysis of ECG, EEG and EMG signals
13. Study of ventilators
14. Study of Ultrasound Scanners
15. Study of heart lung machine model

TOTAL (P: 60) = 60 PERIODS

17GED06 - COMPREHENSION				
	L	T	P	C
	0	0	2	0

PREREQUISITE : ALL CORE SUBJECT

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.	**1.1**	The Student will be able to Understand and comprehend any given problem related to Biomedical Engineering field.	**a,b**

METHOD OF EVALUATION:	**(30)**
The student will be assessed for his understanding of the basic principles of the core engineering subjects. The internal assessment for a total of 50 marks will be evaluated by a committee comprising of the faculty members of the department. The committee will conduct three written examinations of objective question type from the subjects (Test1-Electronic Devices, Circuit Theory, Digital Logic Design; Test 2-Anatomy and Human Physiology, Sensors and Signal Conditioning, Bio Control System: Test 3-Biomedical Instrumentation I & II, Medical Image Processing, Bio signal Processing). The end semester examination, which carries a total of 50 marks, will be an objective question type examination conducted by a committee of one internal examiner appointed by the COE of our college.	
TOTAL (P: 30) = 30 PERIODS	

REFERENCES:

1. Dr.Sanjay Sharma "Electronics and Communication Engineering," 2nd Edition, S.K.Kataria & Sons Publication, New Delhi, 2013.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation, 3rd ed., Tata McGraw-Hill New Delhi, 2014

17GED08 - ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					
			L	T	P	C
			2	0	0	0
PREREQUISITE : Nil					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To Understand the basics of Indian tradition and Indian traditional knowledge systems	**1.1**	The students will be able to Gain Knowledge about of Indian tradition and Indian traditional knowledge systems	**a,f,h**	
2.0	To know about basics of technologies and its scientific perspectives.	**2.1**	The students will be able to Understand basics of technologies and its scientific perspectives.	**a, f**	
3.0	To study the basics of Indian traditional health care ,	**3.1**	The students will be able to study the basics of Indian traditional health care	**a,f,l**	
4.0	To know the basics of Indian artistic tradition knowledge	**4.1**	The students will be able to know the basics of Indian artistic tradition	**a,f,l**	
5.0	To develop the basics of linguistic tradition	**5.1**	The students will be able To develop the basics of linguistic tradition	**a,f,h**	

UNIT I - INDIAN TRADITION:	**(6)**
Fundamental unity of India, India's heroic role in world civilization, The Indian way of life, Introduction to Indian tradition, The Scientific Outlook and Human Values.	
UNIT II - INDIAN KNOWLEDGE SYSTEM AND MODERN SCIENCE:	**(6)**
Relevance of Science and Spirituality, Science and Technology in Ancient India, Superior intelligence of Indian sages and scientists	
UNIT III - INDIAN TRADITIONAL HEALTH CARE:	**(6)**
Importance and Practice of Yoga, Pranayam and other prevailing health care techniques	
UNIT IV - INDIAN ARTISTIC TRADITION:	**(6)**
Introduction and overview of significant art forms in ancient India such as painting, sculpture, Civil Engineering, Architecture, Music, Dance, Literature etc	
UNIT V - INDIAN LINGUISTIC TRADITION:	**(6)**
Ancient Indian languages and literary Heritages, Phonology, Morphology, Syntax and Semantics	
TOTAL = 30 PERIODS	

Text Books:

1. Sivaramakrishnan, V., *Cultural Heritage of India- Course Material*, Bharatiya Vidya Bhavan, Mumbai 5th Edition, 2014
2. Swami Jitatmananda, *Modern Physics and Vedanta*, Bharatiya Vidya Bhavan, 2004.
3. Raman V.V., *Glimpses of Indian Heritage,* Popular Prakashan,1993
4. Jha V.N., *Language, Thought and Reality*
5. Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987.

17MEX36– BIOMECHANICS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17MEC23	**QUESTION PATTERN : TYPE – 3**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To study the application of mechanics in human body	**1.1**	The students will be able to utilize mechanics in medicine	**a, b, c, l**
2.0	To get introduced to the mechanics involved with various physiological systems.	**2.1**	The students will be able to explain the mechanics of physiological systems	**a, b, c, e, j, l**
3.0	To acquire knowledge about orthopaedic mechanics	**3.1**	The students will be able to distinguish the reason for abnormal patterns.	**a, b, c, e, j, l**
4.0	To understand concept of deriving the mathematical models related to blood vessels	**4.1**	The students will be able to analyze the biomechanical systems using mathematical models	**a, b, c, e, j, l**
5.0	To know about various analysis related to biomechanics in human body	**5.1**	The students will be able to design and develop the models specific to orthopedic applications	**a, b, c, e, j, l**

UNIT I : INTRODUCTION TO BIOMECHANICS	**(9)**
Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Bio fluid mechanics, flow properties of blood. Anthropometry.	
UNIT II : MECHANICS OF PHYSIOLOGICAL SYSTEMS	**(9)**
Heart valves, power developed by the heart, prosthetic valves. Constitutive equations for soft tissues, dynamics of fluid flow in cardiovascular system and effect of vibration - shear stresses in extra-corporeal circuits.	
UNIT III : ORTHOPAEDIC MECHANICS	**(9)**
Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of bone, kinetics and kinematics of joints, Lubrication of joints.	
UNIT IV : MATHEMATICAL MODELS	**(9)**
Introduction to Finite Element Analysis, Mathematical models - pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters.	
UNIT V : ORTHOPAEDICAPPLICATIONS	**(9)**
Dynamics and analysis of human locomotion - Gait analysis (determination of instantaneous joint reaction analysis), occupant response to vehicular vibration. Mechanics of knee joint during standing and walking.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Y.C.Fung, "Bio-Mechanics - Mechanical Properties of Tissues'', Springer-Verilog,1998.
2. C. Ross Ether and Craig A.Simmons, "Introductory Biomechanics from cells to organisms", Cambridge University Press, New Delhi, 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.

17BMX01 – BIOMATERIALS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE – 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To Learn characteristics and classification of Biomaterials.	**1.1**	The students can Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.	**a,b,c,d**
2.0	To Understand different metals ,ceramics and its nanomaterials characteristics as biomaterials.	**2.1**	The students can Identify significant gap required to overcome challenges and further development in metallic and ceramic materials.	**a,d,e,g**
3.0	To Learn polymeric materials and its combinations that could be used as a tissue replacement implants.	**3.1**	The students can Identify significant gap required to overcome challenges and further development inpolymeric materials	**b,d,e,h**
4.0	To Get familiarized with the concepts of Nano Science and Technology.	**4.1**	The students can analyze combinations of materials that could be used as a tissue replacement implant.	**b,d,f,g**
5.0	To Understand the concept of biocompatibility and the methods for biomaterials testing	**5.1**	The students can Understand the testing standards applied for biomaterials.	**a,b,c,g,i**

UNIT I: INTRODUCTION TO BIO-MATERIALS	**(9)**
Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.	
UNIT II : METALLIC AND CERAMIC MATERIALS	**(9)**
Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.	
UNIT III: POLYMERIC IMPLANT MATERIALS	**(9)**
Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.	
UNIT IV :TISSUE REPLACEMENT IMPLANTS	**(9)**
Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.	
UNIT V : TESTING OF BIOMATERIALS	**(9)**
Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilization of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

1. Sujata V. Bhatt, "BiomaterialsII", 2nd ed., Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.

REFERENCES :

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003
2. John Enderle, Joseph D. Bronzino, SusanM.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
3. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
4. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran, "Woodhead Medical Textiles and Biomaterials for Healthcare", Publishing Limited, 2006.
5. D F Williams, "Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume", VCH Publishers ,1992.
6. Monika Saini, Yashpal Singh, PoojaArora, VipinArora, and KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.

17BMX02 - MEDICAL PHYSICS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17PYB01		**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To explain the effects of Sound in Human Body.	**1.1**	The students can understand the impact of sound in Human Body.	**a,e,g,h**
2.0	To know the basic principles of Radioactive nuclides and Generators.	**2.1**	The students will be able to apply the Radioactive nuclides in thefield of biomedical Engineering.	**a,e,h**
3.0	To know the concepts of radiation in matter and principles of isotopes generation.	**3.1**	The students will be able to apply the radioactive nuclides in the field of biomedical Engineering.	**d,e,g,h**
4.0	To explains about the basic principle cardiopulmonary systems.	**4.1**	The students will be able to apply the concepts of sounds in Cardiopulmonary systems.	**b,d,e,g**
5.0	Able to Illustrates the methods of detecting and recording the ionizing radiation.	**5.1**	The students will be able to demonstrate various radiation instruments.	**a,e,g,h**

UNIT I:SOUND IN MEDICINE	**(9)**
Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) -Interaction of Ultrasound with matter; Cavitation, Reflection, Transmission Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications	
UNIT II : PRINCIPLES OF RADIOACTIVE NUCLIDES	**(9)**
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide-Reactor produced Radio- nuclide-fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclides, radionuclide Generator-Technetium generator.	
UNIT III: RADIOACTIVE DECAY AND INTERACTIONOF RADIATION WITH MATTER	**(9)**
Spontaneous Fission- Isomeric Transition-Alpha Decay-Beta Decay-Positron Decay-Electron Capture-Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter, Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.	
UNIT IV :PHYSICS OF CARDIOPULMONARY SYSTEMS	**(9)**
The Airways- blood and lung interaction- measurement of lung volume- pressure air flow volume relationships of lungs-physics of alveoli-the breathing mechanism- Major components of cardiovascular systems- 02 and CO2 exchange in the capillary system- Physical activity of heart- trans mural pressure- Bernoulli"s principles applied to cardiovascular system- Blood flow- laminar and turbulent.	

UNIT V :SCINTILLATION, SEMICONDUCTOR AND GAS FILLED DETECTORS	(9)
Scintillation Detectors – Solid Scintillation Counters – Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors – Ionization Chambers-Geiger-Muller Counters.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine," 4th ed., Springer, 2013.
2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, "Medical Physics and Biomedical Engineering", 2nd ed., IOP Publishers.2001.

REFERENCES:

1. S.Webb, " The Physics of Medical Imaging", Taylor and Francis, 1988
2. J.P.Woodcock, " Ultrasonic,Medical Physics Handbook series 1", Adam Hilger, Bristol, 2002
3. HyltonB.Meire and Pat Farrant , "Basic Ultrasound "John Wiley and Sons, 1995

17BMX03 –TELEHEALTH TECHNOLOGY				
L	T	P	C
3	0	0	3

PREREQUISITE : NIL | **QUESTION PATTERN : TYPE - 1**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To learn the key principles for telemedicine and health.	**1.1**	The students can apply multimedia technologies in telemedicine.	**a,e,f,g**
2.0	To understand the types and techniques of telemedicine.	**2.1**	The students can gain knowledge about types and techniques of Telemedicine.	**d,e,g,h**
3.0	To know about ethical And legal aspects of telemedicine	**3.1**	The students can gain knowledge about Ethical and legal aspects of Telemedicine	**a,d,g,h**
4.0	To understand telemedical technology.	**4.1**	The students can explain protocols behind encryption techniques for secure transmission of data.	**a,c,e,f**
5.0	To know telemedical standards, mobile telemedicine and it applications.	**5.1**	The students can Apply telehealth in healthcare.	**a,c,e,g,h**

UNIT I: FUNDAMENTALS OF TELEMEDICINE	**(9)**
History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine. Telemedical Standards.	
UNIT II : TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE	**(9)**
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.	
UNIT III: ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE	**(9)**
Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.	
UNIT IV :PICTURE ARCHIVING AND COMMUNICATION SYSTEM	**(9)**
Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture	
UNIT V : APPLICATIONS OF TELEMEDICINE	**(9)**
Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine, ISRO‟s Telemedicine Network.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

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 Application”, 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”, 3rd ed., Tata McGraw-Hill New Delhi, 2014.
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.

17BMX04 –ARTIFICIAL ORGANS AND IMPLANTS				
L	T	P	C
3	0	0	3

PREREQUISITE : 17BMX01 | **QUESTION PATTERN : TYPE - 1**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To familiarize the students with the origin of universe and Cell biology.	**1.1**	The students can gain adequate Knowledge about artificial organs & transplants.	**a,b,c,d,e**
2.0	To impart an understanding about the Genetics and Bimolecular concepts.	**2.1**	The students can get clear idea about implant design and its parameters and solution.	**a,d,g,e**
3.0	To provide the concepts of enzymes and transfer of Genetic information..	**3.1**	The students can aquiar in-depth knowledge about blood interfacing implants.	**a,e,g,h**
4.0	To understand about the metabolic reactions.	**4.1**	The students can able to describe different types of soft tissue replacement and hard tissue replacement.	**b,c,d,e**
5.0	To provide knowledge about microorganisms and their impact on society	**5.1**	The students can able to gain adequate knowledge about implantable medical devices and organs.	**c,d,f,g**

UNIT I: ARTIFICIAL ORGANS & TRANSPLANTS ARTIFICIAL ORGANS **(9)**

Introduction, outlook for organ replacements, design consideration, evaluation process. TRANSPLANTS- Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II : PRINCIPLES OF IMPLANT DESIGN **(9)**

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III: IMPLANT DESIGN PARAMETERS AND ITS SOLUTION **(9)**

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV : BLOOD INTERFACING IMPLANTS **(9)**

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V : IMPLANTABLE MEDICAL DEVICES AND ORGANS **(9)**

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

1. Kopff W.J, “Artificial Organs”, 1st ed., John Wiley and sons, New York, 1976.
2. Park J.B, “Biomaterials Science and Engineering”, Plenum Press, 1984.

REFERENCES :

1. J D Bronzino, “Biomedical Engineering handbook Volume II”, (CRC Press / IEEE Press), 2000.
2. R S Khandpur, “Handbook of Biomedical Instrumentation” ,Tata McGraw Hill, 2003
3. Joon B Park, “Biomaterials – An Introduction”, Plenum press, New York, 1992.
4. Yannas, I. V, “Tissue and Organ Regeneration in Adults”, New York, NY: Springer, 2001.

17BMX05 –ROBOTICS IN MEDICINE					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17ECC06	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the basics of Robotics, Kinematics.	**1.1**	The students can gain adequate knowledge about the basics of robotic systems.	**a,c,d,i**
2.0	To understand the basics of Inverse Kinematics	**2.1**	The students can design basic Robotics system and formulate Kinematics.	**a,b,d,e**
3.0	To know about various Robotic vision	**3.1**	The students can gain knowledge Robotic vision.	**a,b,c,g**
4.0	To explore various kinematic motion planning solutions for various Robotic configurations.	**4.1**	The students can construct Inverse Kinematic motion planning solutions for various Robotic configurations.	**a,b,c,j**
5.0	To explore various applications of Robots in Medicine.	**5.1**	The students can design Robotic systems for Medical application.	**a,f,k,l**

UNIT I: INTRODUCTION	**(9)**
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	
UNIT II : KINEMATICS	**(9)**
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.	
UNIT III: ROBOT VISION	**(9)**
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.	
UNIT IV : PLANNING	**(9)**
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.	
UNIT V : APPLICATIONS	**(9)**
Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical-Gynaecology, Orthopaedics, Neurosurgery.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Robert Schilling, “Fundamentals of Robotics”, Analysis and control, Prentice Hall, 2003.
2. John J. Craig -Introduction to Robotics, Mechanics and Control., 2018

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, 2012.
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.

17BMX06 – PHYSIOLOGICAL MODELING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17BMC01	QUESTION PATTERN : TYPE - 1				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To explain the application of Physiological models and vital organs.	1.1	The students can gain knowledge about the application of Physiological models.	a,b,c,d
2.0	To formulate the methods and techniques for analysis and synthesis of dynamic models.	2.1	The students can describe the methods And techniques for analysis and synthesis of Linear and dynamic system.	a,d,e,g
3.0	To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.	3.1	The students can develop differential equations to describe the compartmental physiological model.	a,d,e,h
4.0	To describe nonlinear models of physiological systems	4.1	The students can Describe Nonlinear models of physiological systems.	b,c,d,g
5.0	To compute the Simulation of physiological systems.	5.1	The students can Illustrate the Simulation of physiological systems.	a,c,f,g,i

UNIT I: INTRODUCTION TO PHYSIOLOGICAL MODELING	(9)
Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.	
UNIT II : MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM	**(9)**
Dynamic systems and their control, modeling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.	
UNIT III: NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS	**(9)**
Nonparametric Modeling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modeling-Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.	
UNIT IV :COMPARTMENTENTAL PHYSIOLOGICAL MODEL	**(9)**
Modeling the body as compartments, behavior in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.	
UNIT V : SIMULATION OF PHYSIOLOGICALSYSTEMS	**(9)**
Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

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

REFERENCES:

1. Benjamin C Kuo, “Automatic control systems”, 10th ed., McGraw-Hill Education, 2017.
2. DavidTWestwick, Robert E. Kearney, “Identification of Nonlinear Physiological Systems”, Wiley- IEEE Press, 2003.
3. V.Z. Marmarelis, “Advanced methods of physiological modeling” , Springer, 1989
4. L.Stark, “Neurological Control System”, Plenum Press, 1968.
5. John H Milsum , “Biological control systems”, McGraw Hill 1966
6. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su, “Advanced Computational Methods in Life System Modeling and Simulation”, Springer,2017

17BMX07 – NEURAL ENGINEERING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17BMC01	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To discuss the physiological concepts of nerve impulse generation and Electromyography.	**1.1**	The students can understand the physiology behind generation of nerve impulses.	**a,b,c,f**
2.0	To discuss about EEG and its various applications.	**2.1**	The students describe various techniques that are used to evaluate the functioning of central and peripheral nervous system.	**b,c,d,g**
3.0	To explore Evoked potentials and its importance in medicine.	**3.1**	The students can explore Evoked potentials and its importance in medicine.	**c,e,f,h**
4.0	To introduce various techniques to study central and peripheral nerve function.	**4.1**	The students know various techniques about central and peripheral nerve function.	**c,d,e,h**
5.0	To discuss the electrophysiological evaluation in special situations.	**5.1**	The students can Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.	**c,d,f,g,i**

UNIT I: NERVE EXCITABILITY AND ELECTROMYOGRAPHY	**(9)**
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.	
UNIT II : QUANTITATIVE TECHNIQUES IN EEG	**(9)**
Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artifacts 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.	
UNIT III: EVOKED POTENTIALS	**(9)**
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, Somato sensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.	

UNIT IV :FUNCTIONAL NEUROIMAGING AND COGNITION	(9)
Historical and physiological perspective, Functional neuro imaging methods: PET and fMRI, Network analyses, Functional neuro imaging of: Attention, Visual recognition, Semantic memory, Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients.	
UNIT V : ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS	**(9)**
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.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Michael J. Aminoff, "Aminoff„sElectrodiagnosisin Clinical Neurology", 6th ed., Elsevier Saunders, 2012.
2. Kim E. Baretteet. al., "Ganong„s review of Medical Physiology", 23rded., McGraw Hill Medical, 2010.

REFERENCES :

1. A.J. Hudspeth, Eric R. Kandel, James H. Schwartz, Sarah Mack, Steven A. Siegelbaum, Thomas M. Jessell, "Principles of Neural Scienc", McGraw-Hill, New York, 2012.
2. R. Cooper, "Techniques in Clinical Neurophysiology: A Practical Manual", Elsevier, Amsterdam, The Netherlands, 2005.
3. Holodny, Andrei I., "Functional neuroimaging: a clinical approach",. CRC Press , 2019

17BMX08 – FUNDAMENTALS OF NANOSCIENCE					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To discuss the basics concepts nanomaterial science.	**1.1**	The students will familiarize about the science of nano materials.	**a,c,g,h**
2.0	To discuss about preparation method of nanomaterial science.	**2.1**	The students will demonstrate the preparation of nano materials.	**a,d,f,g**
3.0	To explore types of nano science.	**3.1**	The students will develop knowledge in characteristic nanomaterial.	**a,e,h,k**
4.0	To introduce various characterization techniques.	**4.1**	The students know various characterization techniques.	**b,c,e,g**
5.0	To discuss the various applications of nano science.	**5.1**	The students can differentiate various applications of nano science.	**b,c,f,g,i**

UNIT I: INTRODUCTION	**(9)**
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires- ultra-thinfilms- multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).	
UNIT II : GENERAL METHODS OF PREPARATION	**(9)**
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.	
UNIT III: NANOMATERIALS	**(9)**
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc- growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.	
UNIT IV :CHARACTERIZATION TECHNIQUES	**(9)**
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS- Nanoindentation.	
UNIT V :APPLICATIONS	**(9)**
NanoInfoTech:Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "NanoscaleCharecterisation of surfaces & Interfaces", 2nd ed., Weinheim Cambridge, Wiley- VCH, 2008.

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. AkhleshLakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations." Prentice-Hall of India (P) Ltd, New Delhi, 2007.

17BMX09-DISASTER MANAGEMENT				
L	T	P	C	
3	0	0	3	
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide students an exposure to disasters, their significance and types.	**1.1**	The students will be able to exposure to disasters, their significance and types.	**b,c,f**
2.0	To ensure that students begin to Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.	**2.1**	The students will be able differentiate the types of disasters, causes and their impact on environment and society.	**b,c,f**
3.0	To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).	**3.1**	The students will be able to Assess vulnerability and various methods of risk reduction measures as well as mitigation.	**b,c,e**
4.0	To enhance awareness of institutional processes in the country.	**4.1**	The students will be able to enhance awareness of institutional processes in the country.	**b,c,e**
5.0	To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.	**5.1**	Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.	**b,c,f,h**

UNIT I: INTRODUCTION TO DISASTERS	**(9)**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.	
UNIT II : APPROACHES TO DISASTER RISK REDUCTION (DRR)	**(9)**
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.	
UNIT III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	**(9)**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.	
UNIT IV :DISASTER RISK MANAGEMENT IN INDIA	**(9)**
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.	

UNIT V :DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS	(9)
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability, Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management; Biological Disaster,Preparedness and recovery: Case studies.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Singhal J.P., "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. " Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011
4. KapurAnu , "Vulnerable India: A Geographical Study of Disasters", IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES :

1. Govt. of India: "Disaster Management Act" , Government of India, New Delhi, 2005
2. Government of India, "National Disaster Management Policy", 2009.

17BMX10-BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		QUESTION PATTERN : TYPE - 1			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the basic concepts of brain computer interface.	1.1	The students will be able to have comprehended and appreciate the significance and role of this course in the present contemporary world.	a,c,d,i
2.0	To study the various signal acquisition methods.	2.1	The students will be able to evaluate concept of BCI.	a,b,d,e
3.0	To learn about the signal processing methods used in BCI.	3.1	The students will be able to assign functions appropriately to the human and to the machine.	a,b,c,g
4.0	To understand the various machine learning methods of BCI.	4.1	The students will be able to select appropriate feature extraction methods.	a,b,c,j
5.0	To learn the various applications of BCI.	5.1	The students will be able to use machine learning algorithms for translation.	a,f,k,l

UNIT I: INTRODUCTION TO BCI	(9)
. Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous - Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.	
UNIT II : BRAIN ACTIVATION	**(9)**
Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.	
UNIT III: FEATURE EXTRACTION METHODS	**(9)**
Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence	
UNIT IV :MACHINE LEARNING METHODS FOR BCI	**(9)**
Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF„s, Perceptron„s, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.	
UNIT V :APPLICATIONS OF BCI	**(9)**
Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, 1st ed., Cambridge University Press, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, “Brain Computer Interfaces: Principles and practice”, 1st ed., Oxford University Press, USA, January 2012

REFERENCES :

1. Ella Hassianien, A &Azar.A.T (Editors), “—Brain-Computer Interfaces Current Trends and Applications”, Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch, “ A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals”, Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida. Bishop C.M ., “Neural networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.
5. Andrew Webb, “Statistical Pattern Recognition”, 2nd ed., Wiley International, 2002.

17BMX11 - VIRTUAL INSTRUMENTATION FOR BIOMEDICAL ENGINEERS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE – 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the concepts of Virtual Instrumentation Concepts.	**1.1**	The students will be able to explain the Concepts of Virtual Instrumentation Concepts.	**b,c**
2.0	To learn about Programing functions and controls.	**2.1**	The students will be able to program for any real time applications.	**b,c,e,k,l**
3.0	To know about various communication and synchronization techniques.	**3.1**	The students will be able to communication and interface LABVIEW with applications.	**d,e,l**
4.0	To understand the concepts of VI design and Sub VI design.	**4.1**	The students will be able to develop control programs on VI and Sub VI Platform.	**a,i,k**
5.0	Able to relate the data type, control type for Local or global variables..	**5.1**	The students will be able to familiarize With the conceptsof Biomedical applications.	**c,l**

UNIT I: BASIC LABVIEW PROGRAMMING	**(9)**
Data flow – Definition, data flow in LabVIEW – Block diagram, Virtual instrumentation (VI), and sub-VIs - Programming practices – Polymorphism – Definition, benefits – Determination of output or for VI that utilizes polymorphic inputs – LabVIEW Environment -Front panel window, block diagram, and connector pane – Palettes	
UNIT II : SOFTWARE AND PROGRAMMING FUNCTIONS	**(9)**
Front panel window and block diagram objects - Controls, indicators, IO controls, and refnums - Property Nodes -Data types and data structures - Working with objects and data types on front panel windows – Program control structures and data storage - Flat and Stacked sequence structures - Event structures- Formula Node - Arrays and clusters	
UNIT III : DATA COMMUNICATION & SYNCHRONIZATION	**(9)**
Local, global, and shared variables – Data Socket - TCP and UDP – Synchronization – Notifiers – Queues - VI Server - configuring the VI Server - Error handling VIs and functions - Debugging tools and techniques.	
UNIT IV - VIRTUAL INSTRUMENTATION (VI) DESIGN & SUBVI DESIGN TECHNIQUES	**(9)**
Simple state machine - User interface event handler - Queued message handler - Producer/consumer (data) and producer/consumer (events) - Functional global variables - Connector panes and connection types - Polymorphic subVIs - Options related to subVIs - Error handling – User interface design and block diagram layout - Modular and hierarchical design - SubVI icons and connector pane layout (standard) - VI properties - Documenting Vis	
UNIT V- MEMORY, PERFORMANCE AND APPLICATIONS	**(9)**
Tools for identifying memory and performance issues - Profile memory and performance - Show buffer allocations- VI metrics - Programming practices - Enforcing dataflow -User interface updates and response to user interface controls- Data type selection, coercion, and buffer allocation - Array, string, and loop operations -Local and global variables, Property Nodes. Applications of LabVIEW in displaying and monitoring vital parameters, Biomedical signal processing, controlling assistive devices.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. S. Sumathi, P.Surekha, “LabVIEW based Advanced Instrumentation Systems”, Springer 2007.
2. Gary Jonson, “LabVIEW Graphical Programming”, 4th ed.,McGraw Hill, New York, 2006.
3. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, PHI Learning Pvt. Ltd., 2010

REFERENCES :

1. Jon B Olansen and Eric Rosow, “Vitrual Bio-Instrumentation Biomedical, Clinical and Healthcare Applications in LabVIEW” 2001.
2. Rick Bitter, TaqiMohiuddin, Matt Nawrocki ,“LabVIEW: Advanced Programming Techniques”, 2nd ed., CRC press, 2007.
3. Lisa K. Wells & Jeffrey Travis, “LabVIEW for Everyone”, 1st ed., Prentice Hall Inc., 1997.
4. S. Gupta, J.P. Gupta, “PC interfacing for Data Acquisition & Process Control”, 2nd ed., Instrument Society of America, 1994

17ECX12- HOSPITAL MANAGEMENT					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To understand the fundamentals of hospital administration and management.	**1.1**	The students can able to explain the principles of Hospital administration	**g,h,i**	
2.0	To identify the importance of Human resource management.	**2.1**	The students will be able to identify the importance of Human resource management.	**c,d,g,i**	
3.0	To know the market related research process	**3.1**	The students will be able to list various marketing research techniques.	**c,d,f,i**	
4.0	To explore various information management systems and relative supportive services.	**4.1**	The students will be able to identify Information management systems and its uses.	**d,f,j,k**	
5.0	To learn the quality and safety aspects in hospital.	**5.1**	The students will be able to understand safety procedures followed in hospitals.	**c,e,g,k**	

UNIT I - OVERVIEW OF HOSPITAL ADMINISTRATION	**(9)**
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.	
UNIT II - HUMAN RESOURCE MANAGEMENT IN HOSPITAL	**(9)**
Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – I Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, P and modes of communication.	
UNIT III- MARKETING RESEARCH PROCESS	**(9)**
Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.	
UNIT IV - HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES	**(9)**
Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department-Pharmacy– Food Services - Laundry Services.	
UNIT V- QUALITY AND SAFETY ASPECTS IN HOSPITAL	**(9)**
Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES :

1. Cesar A.Caceres and Albert Zara, ―The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, ―Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman ―Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.
4. William A. Reinke ―Health Planning For Effective Management‖ - Oxford University Press.1988
5. Blane, David, Brunner, ―Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, ―Health Care Management‖, 6th Edition Cengage Learning, 2011.

17GEA04 - PROFESSIONAL ETHICS AND HUMAN VALUES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the theory of engineering ethics.	**1.1**	Students know the concepts of ethics and values.	**f, h**
2.0	To enable the students to create an awareness on Engineering Ethics and Human Values.	**2.1**	Students acquire the knowledge of interpersonal and organizational issues in ethics	**f, h**
3.0	To instill Moral and Social Values and Loyalty.	**3.1**	Students will be able to Highlight the ethical issues related to engineering.	**f, h, i, l**
4.0	To appreciate the safety, responsibilities and rights of others.	**4.1**	Students can learn the concepts of engineer's responsibilities and their rights.	**f, h, i, l**
5.0	To understand the role of professional bodies	**5.1**	Students will be able to understand the role of global issues and professional bodies.	**f, h, i, l**

UNIT I - HUMAN VALUES	**(9)**
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality- Introduction to Yoga and meditation for professional excellence and stress management.	
UNIT II - ENGINEERING ETHICS	**(9)**
Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	
UNIT III - ENGINEERING AS SOCIAL EXPERIMENTATION	**(9)**
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger case study – Bhopal Gas Tragedy and Chernobyl case studies.	
UNIT IV - SAFETY, RESPONSIBILITIES AND RIGHTS	**(9)**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	

UNIT V - GLOBAL ISSUES	(9)
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", 4th Edition , Tata Mc Graw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India Private Limited, New Delhi, 20012.

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2008.
4. Web sources: 1. www.onlineethics.org 2. www.nspe.org 3. www.globalethics.org 4. www.ethics.org.

17ECX12- PROTOCOLS AND ARCHITECTURES FOR WIRELESS SENSOR NETWORKS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			
COURSE OBJECTIVES AND OUTCOMES:					

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make students to learn the enabling Technologies for Wireless Sensor Networks.	**1.1**	The Students can apply their knowledge in the sensor network applications.	**b,c**
2.0	To enable the student to understand the network architecture	**2.1**	The Students will be able to analyse about the energy efficient network design.	**b,c,e,k,l**
3.0	To enable the student to understand Design Considerations of WSN	**3.1**	The Students will be able to design sensor network	**d,e,l**
4.0	To motivate the students to know the infrastructure establishment	**4.1**	The students will be able to analyse the Time Synchronization, Localization and Positioning, Sensor Tasking and Control of sensors.	**a,i,k**
5.0	To make the students to understand the different routing protocols.	**5.1**	The students will be able to routing protocol secured network design	**c,l**

UNIT I - OVERVIEW OF WIRELESS SENSOR NETWORKS	**(9)**
Introduction to wireless sensor network- Sensor network applications, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.	
UNIT II - ARCHITECTURES	**(9)**
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Service interfaces of WSNs.	
UNIT III- NETWORKING SENSORS	**(9)**
Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , Assignment of MAC Addresses.	
UNIT IV - INFRASTRUCTURE ESTABLISHMENT	**(9)**
Topology Control- Controlling topology in flat networks, Hierarchical networks by dominating sets, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	
UNIT V- ROUTING PROTOCOL	**(9)**
Introduction to routing protocol, Broadcast and multicast, Geographic routing, Mobile nodes, Energy efficient unicast, Advanced application support- Network processing, WSN security.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 2012.

REFERENCES :

1. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.
3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

17ECC21 - EMBEDDED AND REAL TIME SYSTEMS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : 17ECC13	**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	Learn the architecture and programming of ARM processor	**1.1**	The students will be able to Describe the architecture of different ARM processor cores.	**a,b,f,i,k**
2.0	Be familiar with the embedded computing platform design and analysis.	**2.1**	The students will be able to Understand the instruction set and Assembly Language Programming in ARM.	**a,c,f,j**
3.0	Be exposed to the basic concepts of real time Operating system.	**3.1**	The students will be able to Categorize and understand the recent trends in Embedded Systems.	**a,d,i,k**
4.0	Learn the system design techniques and networks for embedded systems.	**4.1**	The students will be able to Outline the concepts of embedded systems and explain the basic concepts of real time Operating system design.	**a,b,f,k**
5.0	To make the students to develop the real time solutions	**5.1**	The students will be able to Develop real time solutions in different RTOS environment.	**a,b,c,i,l**

UNIT- I ARCHITECTURE OF EMBEDDED SYSTEMS	**(9)**
Categories of Embedded Systems- Specialties of Embedded systems-Recent trends in Embedded Systems-Hardware Architecture-Software Architecture-Communication software-Process of generation of executable image-development/testing tools.	
UNIT-II THE ARM RISC ARCHITECTURE	**(9)**
The Reduced Instruction Set Computer – Architectural inheritance-The ARM programmers model - ARM Development Tools.-ARM organization and implementation: 3 stage and 5 stage pipeline ARM organization-ARM instruction execution- ARM processor cores: ARM7 TDMI- Comparison of ARM8 TDMI-ARM9 TDMI.	
UNIT-III ARM INSTRUCTION AND ASSEMBLY LANGUAGE PROGRAMMING	**(9)**
Exceptions-Conditional execution-Branch and branch with link and exchange-Software interrupt-Data processing instructions-Single word and unsigned byte data transfer and half word and signed byte data transfer instructions-Multiple register transfer instructions-Swap instructions-The thumb instruction set - Thumb applications.	
UNIT-IV RTOS CONCEPTS	**(9)**
Architecture of the Kernel-task and task scheduler-Interrupt Service Routines-Semaphores-Mutex- Mailboxes-Message Queues-Event Registers-Pipes-Signals-Timers-Memory Management – Priority Inversion Problem.	
UNIT V- RTOS IMPLEMENTATION	**(9)**
Off the shelf operating system – embedded operating system – Real time operating system:VX works- Micro C/OS-II hand held operating system : Palm OS- Symbian OS - Case study of coding for an Automatic Chocolate Vending Machine using MUCOS -RTOS- Case study of an Embedded system for an Adaptive Cruise Control Systems in a Car- Case study of an Embedded Systems for a Smart Card.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Dr.K.V.K.K Prasad "Embedded Real-Time systems: concept, design & Programming" Dream tech Press, Reprint Edition, 2010.
2. Steve furber "ARM system On Chip Architecture" Pearson 16th Edition 2013

REFERENCES :

1. Raj Kamal "Embedded Systems Architecture Programming and Design" 2nd Edition TMH, 2010
2. Wayne Wolf, "Computers as Components - Principles of Embedded Computer System Design", Morgan Kaufmann Publisher, 2nd Edition 2006.

17ECX16 – INTERNET OF THINGS AND ITS APPLICATIONS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE - 1**				

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To make the students to know about basics of Electrical and Electronic devices	**1.1**	The students will be able to understand basics of Electrical circuits and Electronic devices	**a,c,d,i**
2.0	To make the students to know about basics and block diagram of IoT	**2.1**	The students will be able to understand IOT characteristics and its essential components.	**a,b,d,e**
3.0	To make the students to know about Arduino processor and working of Analog and Digital I/O pins	**3.1**	The students will be able to describe Arduino processor and working of Analog and Digital I/O pins	**a,b,c,g**
4.0	To make the students to know about Raspberry pi and its interface with other devices	**4.1**	The students will be able to understand Raspberry pi and its interface with other devices	**a,b,c,j**
5.0	To motivate the students to implement the IoT using Arduino/ Raspberry Pi.	**5.1**	The students will be able to implement a IoT system using Arduino/Raspberry Pi.	**a,f,k,l**

UNIT I - BASIC ELECTRICAL CIRCUITS AND ELECTRONICS	**(9)**
Introduction - Current, voltage and resistance - Analog and Digital Signal - conductors Vs Insulators – KCL- KVL - Basic Electronics components - calculating equivalent resistance for series and parallel circuits- Ohm's law- Color coding for a resistor – LED – LCD - LDR.	
UNIT II - INTRODUCTION TO INTERNET OF THINGS	**(9)**
Introduction - Definition and characteristics of Internet of Things - General Block Diagram and essential components of IOT - Role of microprocessor & Micro controller- communication of things - IOT connection with internet.	
UNIT III- ARDUINO PROCESSOR	**(9)**
Introduction to Arduino processor- General Block diagram- Working of Analog and Digital I/O pins- Serial (UART) , I2C Communications and SPI communication - Arduino Boards: Mega, Due, Zero and 101 - Prototyping basics - Technical description - Setting Up Arduino IDE- Introduction to Arduino programming.	
UNIT IV - RASPBERRY PI	**(9)**
Technical Description of Raspberry Pi - comparison of Raspberry Pi Vs Arduino - Operating Systems for RPi - Preparing SD Card for Pi - Connecting Raspberry Pi as PC - Exploring Raspberry Pi Environment- Logical design using Python.	
UNIT V- APPLICATIONS OF IOT	**(9)**
Various Real time applications of IoT- automation - Smart Parking - Environment: Weather monitoring system - Agriculture: Smart irrigation – Domain Specific applications.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015.

REFERENCES :

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition, (2006).

2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd edition, 2013.
3. Marco Schwartz, ― Internet of Things with the Arduino Yun, Packt Publishing, 2014.
4. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley Publications, 2012.

17CSX31- PROBLEM SOLVING AND PROGRAMMING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17CSC01 / 17CSC02		**QUESTION PATTERN : TYPE 1**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To gain knowledge about the basics of programming	**1.1**	The students will be able to understand the basics of Python Programming constructs.		**a,c,l**
2.0	To gain exposure about selection structure	**2.1**	The students will be able to design programs involving selection structure		**a,b,c,d,l**
3.0	To get knowledge about repetition structure, function and modules	**3.1**	The students will be able to design programs involving function, modules and loops.		**a,b,c,d,k,l**
4.0	To gain exposure about string	**4.1**	The students will be able to realize the need of strings.		**a,b,c,d,k,l**
5.0	To get knowledge about mutable and Immutable types	**5.1**	The students will be able to realize the need of list, tuples and dictionary.		**a,b,c,d,k,l**

UNIT I - INTRODUCTION TO BASICS OF PROGRAMMING	**(9)**
Basics - Variables and Assignment - Basic Data Types- Comments - Operators - print() - Floats	
UNIT II - SELECTION STRUCTURE	**(9)**
Introduction to Selection Structure - if statements, else statements, nested elif statements, truthy and falsey values, Control Structure	
UNIT III - VALUE – REPETITION AND RETURNING STRUCTURE	**(9)**
Loops - while loops, for loops - Nested Loops - Functions - modules - variable scope	
UNIT IV - DATA AND STRING PROCESSING	**(9)**
Strings - Accessing the Strings - Traversing the Strings - Working with Strings - Formatting Strings	
UNIT V - MUTABLE AND IMMUTABLE TYPES AND METHODS	**(9)**
Introduction to lists, indexing and slicing of list, del and list methods, Tuples, Dictionary and its methods.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Dr. R. Nageswara Rao, ―Core Python Programming, Dreamtech Press, 2017 Edition.
2. Reema Thareja - Problem Solving and Programming – Python, Oxford University Press, 2nd Edition.

REFERENCES:

1. Wesley J. Chun, ―Core Python Programming, Pearson Education, 2nd edition, 2010.

17ITX26- PROBLEM SOLVING AND ALGORITHMIC SKILLS					
			L	T	P	C
			3	0	0	3
PREREQUISITE: NIL		**QUESTION PATTERN : TYPE – 1**			
COURSE OBJECTIVES AND OUTCOMES					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To impart fundamental concepts of OOP using python	**1.1**	The students will be able to understand the basics of object oriented concepts in python.		**a,c,l**
2.0	To gain exposure about inheritance and polymorphism	**2.1**	The students will be able to develop applications using inheritance and polymorphism		**a,b,c,d,e,k,l**
3.0	To understand the abstract data types and tree data structures	**3.1**	The students will be able to implement the ADTs and trees		**a,b,c,d,e,k,l**
4.0	To see how graphs and heaps can be used to solve a wide variety of problems	**4.1**	The students will be able to design graph abstract data type and heap		**a,b,c,d,e,k,l**
5.0	To understand the sorting techniques and shortest path algorithms.	**5.1**	The students will be able to implement the sorting techniques and shortest path algorithms.		**a,b,c,d,e,k,l**

UNIT I - MOTIVATION OF FUNDAMENTAL CONCEPT IN PROGRAMMING	**(9)**
Implementation of Classes and Objects in Python - Class Attributes and Instance Attributes - 'self ' parameter - Static Methods and Instance Methods - init() method	
UNIT II - ADVANCED FEATURES IN CONCEPT OF PROGRAMMING	**(9)**
Performing Abstraction and Encapsulation in Python - Single Inheritance - Multiple Inheritance - Multilevel Inheritance - Public, Protected and Private - Naming Conventions. Polymorphism- Overriding and the super() method - Diamond Shape Problem in Multiple Inheritance - Overloading an Operator - Implementing an Abstract Base Class (ABC)	
UNIT III - INTRODUCTION TO ALGORITHMIC THINKING AND PEAK FINDING	**(9)**
Array data structure - Linked List Data Structure and Its Implementation - Stacks and Queues - Binary Search Trees - Balanced Trees: AVL Trees and Red-Black Trees	
UNIT IV - MAPPING VALUES AND PRINCIPLE OF OPTIMALITY	**(9)**
Heaps - Heapsort Algorithm - Associative Arrays and Dictionaries - Ternary Search Trees as Associative Arrays - Basic Graph Algorithms - Breadth - First And Depth - First Search - Spanning Trees	
UNIT V - ANALYZING NUMBER OF EXCHANGES IN CRAZY-SORT	**(9)**
Shortest Path Algorithms, Dijkstra's Algorithm - Bellman-Ford Algorithm - Kruskal Algorithm - Sorting Algorithms- Bubble Sort, Selection Sort and Insertion Sort - Quicksort and Merge Sort, Non-Comparison Based Sorting Algorithms, Counting Sort and Radix Sort	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Dusty Phillips, Python 3 Object-oriented Programming, Packt Publishing, Second Edition.
2. Bradley N. Miller, David L. Ranum,- Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates, 2011.

REFERENCES:

1. Mark Summerfield - Programming in Python 3, Pearson Education, 2nd Edition
2. Michael T. Goodrich, Irvine Roberto Tamassia, Michael H. Goldwasser, - Data Structures and Algorithms in Python‖, 2013 edition.

17ITC12 - DATABASE SYSTEMS CONCEPTS				
L	T	P	C	
3	0	0	3	
PREREQUISITE : NIL	**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the different issues involved in the design and implementation of a database system.	**1.1**	The students will be able to describe the role of Database Management System in an Organization.	**a,c,j,k**
2.0	To study the physical and logical database designs, database modeling.	**2.1**	The students will be able to study basic database concepts including the structure and operations of the relational data model.	**a,c,j,k**
3.0	To understand and use data manipulation language to query, update, and manage a database	**3.1**	The students will be able to construct simple and Moderately advanced database queries using SQL.	**a,b,c,j,k**
4.0	To develop an understanding of essential DBMS concepts.	**4.1**	The students will be able to apply logical database design principles includes E-R diagrams & Normalization.	**a,b,c,k**
5.0	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.	**5.1**	The students will be able to explain various file organizing & Indexing structure.	**a,b,c,k**

UNIT I - INTRODUCTION	**(9)**
Introduction to database systems - Definition of DBMS - Advantages of dbms - Views of data - Levels of data abstraction - Data Models and types - Database architecture - Entity relationship model - ER diagram.	
UNIT II - RELATIONAL DATA MODEL	**(9)**
Relational database structure - Procedural and Non procedural languages - Relational algebra : operations - Relational Calculus : Tuple relational calculus - Domain Relational Calculus - Integrity Constraints - SQL Commands : DDL - DML - TCL.	
UNIT III - DATABASE DESIGN	**(9)**
Functional dependency: Full functional Dependency - Partial dependency - Transitive dependency - multi valued dependency - Decomposition - Normalization - Normal Forms: 1NF - 2NF - 3NF - BCNF - 4NF - 5NF.	
UNIT IV - TRANSACTIONAL PROCESSING	**(9)**
Transaction - Properties of transaction - Transaction state - Serialization : types - Need for Serialization - Two Phase Commit - Save Point - Concurrency - Advantages of concurrency - Concurrency control mechanism - Locking protocols	
UNIT V - MEMORY STRUCTURES AND FILE ORGANIZATION	**(9)**
Memory hierarchy - Disk storage - Raid levels - Indexing: types - Hashing techniques - Query Processing tool - Query Evaluation.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2010.

REFERENCES:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.

17GEA03 - TOTAL QUALITY MANAGEMENT					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE - 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To acquire various concepts of quality management.	**1.1**	Students can acquire various concepts of quality management.	**b,c,f**
2.0	To implement various principles of quality management.	**2.1**	Students can implement various principles of quality management.	**b,c,f**
3.0	To impart quality using statistical process.	**3.1**	Students will be able to impart quality using statistical process.	**b,c,e**
4.0	To use the various tools to maintain quality.	**4.1**	Students can learn to use the various tools to maintain quality.	**b,c,e**
5.0	To implement the quality system for ISO certification.	**5.1**	Students can implement the quality system for ISO certification.	**b,c,f,h**

UNIT I – INTRODUCTION	**(9)**
Definitions-Basic approach –Gurus of TQM- TQM Framework -Defining Quality- Dimensions of quality- Benefits of TQM – Leadership: Leadership Concepts – The Deming philosophy - Quality council - Quality statements- Strategic planning- Customer satisfaction: Customer perception of quality- Using customer complaints- service quality- Customer retention.	
UNIT II - TQM PRINCIPLES	**(9)**
Employee involvement: Motivation- Empowerment- Teams- Recognition and Reward- Performance appraisal – Continuous process improvement: The Juran Trilogy – PDSA cycle- Kaizen – Six sigma - Supplier Partnership: Partnering, Supplier selection - Supplier Rating.	
UNIT III- TQM TOOLS AND TECHNIQUES- I	**(9)**
Bench marking - Reason to bench mark, process – Quality Function Development (QFD)- Failure mode and effect analysis – Stages of FMEA- Other types of FMEA-Management tools: Tree diagram- Matrix diagram- Process decision program chart-Activity network diagram.	
UNIT IV - TQM TOOLS AND TECHNIQUES- II	**(9)**
Statistical process control: Pareto diagram –Process flow diagram- Cause and effect diagram- Histogram-Charts – Variable control chart-Control chart for attributes-Scatter diagrams -Process Capability – Total productive maintenance: Learning the new philosophy-Training-Improvement needs.	
UNIT V- QUALITY MANAGEMENT SYSTEMS	**(9)**
Benefits of ISO registration-ISO 9000 series of standards–ISO 9001 Requirements- implementation, Documentation, Internal Audits – Environmental Management system- ISO 14000 series standards- Concepts of ISO 14001- Requirements of ISO 14001- Benefits of EMS.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint,

2011.

REFERENCES :

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th ed., First Indian Edition, Cengage Learning, 2012.
2. Subburaj Ramasamy , “Total Quality Management”, Tata McGrawHill, First reprint 2009.
3. Suganthi. L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

17BMC08 - MEDICAL IMAGING TECHNIQUES					
			L	T	P	C
			3	0	0	3
PREREQUISITE : 17BMC04		**QUESTION PATTERN : TYPE – 1**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understanding of the radiographic and fluoroscopic principles, related hardware and to identify the differences.	**1.1**	The students can able to explain the concepts of radiographic and fluoroscopic principles.	**a,b,c,d**
2.0	To understand the principles underlying the working of CT machines, hardware and to differentiate between its reconstruction techniques.	**2.1**	The students can able to summarize the working principles of CT machines, hardware and to differentiate between its reconstructions techniques.	**b,c,e,g**
3.0	To know the concepts of radioisotopes and working of Nuclear imaging systems.	**3.1**	The students can able to describe the concepts of radioisotopes and working of Nuclear imaging systems.	**a,c,e,h**
4.0	To learn the principles of Ultrasound and the working concept of Ultrasound scanners.	**4.1**	The students can able to interpret the principles of Ultrasound and the working concept of Ultrasound scanners	**c,e,f,g**
5.0	To gain knowledge about the principles of MRI, hardware, reconstruction techniques and its effect on the body	**5.1**	The students can able to relate the knowledge about the principles of MRI, hardware, reconstruction techniques and its effect on the body	**b,c,f,g**

UNIT I - RADIOGRAPHIC IMAGING	**(9)**
Point spread, Line spread and Modulation Transfer Function. Details of radio graphics and fluoroscopic images in X-ray systems, Screen, film and image intensifier systems. Digital Radiography.	
UNIT II – X-RAY COMPUTED TOMOGRAPHY	**(9)**
Basic principle, Evolution of CT machines, Acquisition, Processing, Reconstruction, Viewing and storage systems, Gantry geometry.	
UNIT III- NUCLEAR MEDICAL IMAGING SYSTEMS	**(9)**
Radio-isotopes, Physics of radioactivity, Radiation detectors, Pulse height analyzers, Uptake monitoring equipment, Rectilinear scanner, Gamma Camera, Emission Computed Tomography, PET scanner, Principle, Data acquisition, Principles of Digital Subtraction Angiography, Picture Storage and archiving systems in Medical imaging.	
UNIT IV - ULTRASONIC IMAGING SYSTEM	**(9)**
Diagnostic Ultrasound, Physics of Ultrasonic waves, Basic pulse-echo apparatus, Principles of A- Mode, B-Mode, M-Mode, Real time Ultrasonic (B-Scan) imaging systems, Requirements, Multi- element Linear array scanners, Digital scan converters, Biological effects of ultrasound.	
UNIT V- MAGNETIC RESONANCE IMAGING SYSTEM	**(9)**
Principles of NMR imaging system, Image acquisition in MRI, T1, T2, Proton density weighted images, Artifacts in imaging, Pulse sequences, conventional, fast acquisition, image reconstruction techniques, Basic NMR components, Biological effects of MRI, Advantages.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Khandpur.R.S. Handbook of Biomedical Instrumentation.2nd edition Tata McGraw Hill Pub. Co., Ltd.
2. John Ball andTony Price.Chesney's RadiographicImaging. 6th edition Blackwell Science Limited, U.K.

REFERENCES:

1. Farr. (2007). The Physics of Medical Imaging. Adem Hilger, Bristol & Philadelphia.
2. Joseph Bronzino. (2005). The Physics of Medical Imaging. Second edition.

17BMC09 - REHABILITATION ENGINEERING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 17BMX01		**QUESTION PATTERN : TYPE – 1**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To Study basics concepts of Rehabilitation Engineering	**1.1**	The Students can able to gain adequate knowledge about the needs of rehabilitations and its future development.	**a,b,c,d**	
2.0	To Learn the design of Wheel Chairs	**2.1**	The Students can able to illustrate depth idea about the design of Wheel Chairs.	**b,c,e,g**	
3.0	To Understand various assistive technology for vision & hearing	**3.1**	The students can design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society.	**a,c,e,h**	
4.0	To describe the fundamentals and application of motor rehabilitation	**4.1**	The students can design various motor rehabilitation and their application in biomedical field.	**c,e,f,g**	
5.0	To gain knowledge of the recent developments in the field of rehabilitation engineering	**5.1**	The students will be able to build computer based applications to improve the quality of life of individuals with disabilities.	**b,c,f,g,l**	

UNIT I - INTRODUCTION TO REHABILITATION	**(9)**
Rehabilitation concepts, engineering concepts in sensory rehabilitation, motor rehabilitation, communication disorders, examples of rehabilitation engineering - Sensory augmentation & substitution - Visual system, auditory system, tactual system.	
UNIT II - WHEEL CHAIR ENGINEERING	**(9)**
Wheeled mobility - categories of wheel chairs - wheel chair structure & component design - ergonomics of wheel chair propulsion - power wheel chair electrical system - personal transportation.	
UNIT III- SENSORY REHABILITATION	**(9)**
Rehabilitation of the blind - reading aids, tactile vision, aids for the deaf, audiometry and speech therapy aids, automatic speech synthesis & voice recognition.	
UNIT IV - MOTOR REHABILITATION	**(9)**
Orthopedic prosthetics and orthotics in rehabilitation: fundamentals, applications, computer Aided engineering in customized component design, Intelligent prosthetic knee, A hierarchically controlled prosthetic hand, A self-aligning orthotic knee joint, externally powered and controlled orthotics and prosthetics, FES systems: restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS), Active prostheses: active above knee prosthesis, myoelectric hand and arm prostheses, MARCUS intelligent hand prosthesis.	
UNIT V- COMPUTER APPLICATIONS IN REHABILITATION	**(9)**
Augmentative communication, control and computer access, AAC: user interface, outputs, acceleration techniques, cost-effectiveness of high Vs low - technology approaches, intervention and other issues, environmental control systems, robotic and manipulation aids, environmental control and access to computers.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Joseph D.Bronzino, The Biomedical Engineering Handbook, Fourth edition 4th- volume set, Donald R, Peterson, 2015
2. Rory A Cooper, ―An Introduction to Rehabilitation Engineering‖, Taylor & Francis, New York, 2007.

REFERENCES:

1. Horia- Nocholai Teodorecu, L.C.Jain ,Intelligent systems and technologies in rehabilitation Engineering; CRC; December 2000.
2. Warren E. Finn,Peter G. LoPresti; Handbook of Neuroprosthetic Methods CRC; edition 2002.

17BMP06 – HOSPITAL INTERNSHIP							
				L	T	P	C
				0	0	2	1
PREREQUISITE:NIL			**QUESTION PATTERN : TYPE –NIL**				
COURSE OBJECTIVES AND OUTCOMES:							
Course Objectives		**Course Outcomes**		**Related Program outcomes**			
1.0	To Observe medical professionals at work in the wards and the roles of Allied Health Professionals;	**1.1**	The students can advocate a patient-centred approach in healthcare	**a,b,e,f**			
2.0	To provide access to healthcare Professionals to get a better understanding of their work;	**2.1**	The student can communicate with other health professionals in a respectful and responsible manner	**a,b,e,f**			
3.0	To recognize the importance of inter-professional collaboration in healthcare.	**3.1**	The students will be able to recognize the importance of inter-professional collaboration in healthcare.	**a,c,d,f,i**			
4.0	To demonstrate patient-care in a hospital setting.	**4.1**	The student can propose a patient-centred inter-professional health improvement plan based upon the patient‘s perceived needs	**a,c,d,g,j**			
5.0	To use the knowledge of one‘s own role and those of other professions to address the healthcare needs of populations and patients served.	**5.1**	The students can use the knowledge of one‘s own role and those of other professions to address the healthcare needs of populations and patients served.	**c,d,f,h**			

ASSESSMENT:

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

Departments for visit
1. Cardiology –ECG machine, Pacemaker, Defibrillator, Pulse Oximeter 2. ENT- Endoscopes, Hearing screening instruments, Hearing aids 3. Ophthalmology- Tonometers, Retinoscope 4. Orthopaedic and Physiotherapy- Goniometers, Manual muscle testing dynamometer 5. ICU/CCU- Ventilator/Respirator, Patient monitor, Infusion pump 6. Operation Theatre- Anesthesia machine, Surgical table bed 7. Neurology- EEG Monitoring System, EMG Machine 8. Nephrology- Hemodialysis machines , Microscope, Colorimeter 9. Radiology - X-rays, MRI,CT, Fluoroscopy, Ultrasound, Echocardiography, PET. 10. Nuclear Medicine - Special gamma camera and single-photon emission-computed tomography (SPECT) 11. Pulmonology - Fiberoptic Bronchoscope, Rigid Bronchoscope, spirometry, Arterial Blood Gas Machine 12. Urology - Cystoscope, Urethral sound 13. Obstetrics and Gynaecology - Ultrasound machine, Suction machine, Fetal Doppler 14. Emergency Medicine- Ventilators, Foetal Monitor, Tonometer 15. Biomedical Engineering Department - Anesthesia machine, Aspiration/Suction Pump, Autoclave / Sterilizer 16. Histo Pathology- Confocal Microscopy, Histology Tissue Processors, Compound Light Microscopes 17. Biochemistry- Spectrophotometer, Electrophoresis, Electrolyte analyzer, Autoanalyser 18. Paediatric/Neonatal- Neonatal Ventilator, Transport Incubator, Bubble CPAP 19. Dental- Dental mirror, Excavators, Curettes 20. Oncology- linear accelerators, ICU ventilators, Ultrasound system 21. PAC's- Patient monitor, Defibrillators, Syringe Pump, Infusion Pump 22. Medical Records / Telemetry- Battery-powered, Patient worn transmitters
TOTAL (P: 60) = 60 PERIODS

17BMD01 – PROJECT WORK - I				
L	T	P	C
0	0	8	4

PREREQUISITE : NIL | **QUESTION PATTERN : TYPE –NIL**

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.	**1.1**	The students will be able to identify specific problems in the field of Biomedical Engineering	**a,b,e,f**
2.0	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.	**2.1**	The students will be able formulate new ideas for the identified problem either as individual or as team.	**a,c,d,h,i**
3.0	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.	**3.1**	The students will be able to provide solutions to complex problems addressing technical and social issues	**a,b,c,e,f,h**
4.0	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.	**4.1**	The students will be able to demonstrate their skills effectively	**a,c,g,j,k**
5.0	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	**5.1**	The students will be able to present their report in a professional manner	**f,g,i,j,l**

DESCRIPTION

Project work may be allotted to a single student or to a group of students not exceeding 4 per group. The title of project work is approved by Head of the Department under the guidance of a faculty member. The Head of the Department shall constitute a review committee for project work. There shall be three reviews during the semester by the committee to review the progress. Student(s) shall prepare a formal report describing the work undertaken and results obtained. Student(s) need to present the work in the form of demonstration of operational hardware or software. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations

TOTAL (P: 120) = 120 PERIODS

17BMD02 – PROJECT WORK-II					
		L	T	P	C
		0	0	16	8
PREREQUISITE : 17BMD01		**QUESTION PATTERN : TYPE –NIL**			

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.	**1.1**	The students will be able to identify specific problems in the field of Biomedical Engineering	a,b,e,f
2.0	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.	**2.1**	The students will be able formulate new ideas for the identified problem either as individual or as team.	a,c,d,h,i
3.0	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.	**3.1**	The students will be able to provide solutions to complex problems addressing technical and social issues	a,b,c,e,f,h
4.0	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.	**4.1**	The students will be able to demonstrate their skills effectively	a,c,g,j,k
5.0	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	**5.1**	The students will be able to present their report in a professional manner	f,g,i,j,l

DESCRIPTION

Project work may be allotted to a single student or to a group of students not exceeding 4 per group. The title of project work (same title as in project work-I if the same project is continued in project work-II or the title will be selected based on different project) is approved by Head of the Department under the guidance of a faculty member. The Head of the Department shall constitute a review committee for project work. There shall be three reviews during the semester by the committee to review the progress. There shall be three reviews during the semester by the committee to review the progress. Student(s) shall prepare a formal report describing the work undertaken and results obtained. Student(s) need to present the work in the form of demonstration of operational hardware or software. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations

TOTAL (P: 240) = 240 PERIODS

17BMX13 – MEDICAL ETHICS AND STANDARDS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL		**QUESTION PATTERN : TYPE – 1**			
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To achieve familiarity with some basic ethical framework& understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.	**1.1**	The Students can able to identify the scope of medical ethics.	**a,e,f,g**	
2.0	To know about Medical Standards and Regulations.	**2.1**	The Students can able to apply the concepts of ethical theories and moral principles for the health professions.	**d,e,g,h**	
3.0	To know about the legal and ethical principles and application of these principles in health care settings.	**3.1**	The Students can able to apply medical standards in their practice.	**a,d,g,h**	
4.0	To gain knowledge about the medical standards that to be followed in hospitals.	**4.1**	The Students can able to summarize the importance of hospital safety standards.	**a,c,e,f**	
5.0	To learn about suitable principles of medical equipment safety standards in hospitals.	**5.1**	The Students can able to recommend the suitable principles of medical equipment safety standards in hospitals.	**a,c,e,g,h**	

UNIT I - INTRODUCTION TO MEDICAL ETHICS	**(9)**
Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and the Patient, The Doctor and the Profession, Professional Independence, The Doctor and Society.	
UNIT II - ETHICAL THEORIES & MORAL PRINCIPLES	**(9)**
Theories-Deontology& Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles - Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research, Bioethical issues in Human Genetics & Reproductive Medicine.	
UNIT III - MEDICAL DEVICES STANDARDS	**(9)**
Medical Standards and Regulations – Device classification – Registration and listing – Declaration of conformance to a recognized standard – Investigational Device Exemptions – Institutional Review Boards – IDE format – Good laboratory practices – Good manufacturing practices. Concept of Software as a Medical Device (SaMD)	

UNIT IV - MEDICAL DEVICES HANDLING AND ENVIRONMENTAL SAFETY	(9)
Safe medical devices – Handling and operation – Medical Application safety – Usability – Clinical assessment – Environmental safety.	
UNIT V - RELIABILITY AND ELECTRICAL SAFETY TESTING	**(9)**
Reliability – Types of reliability – Reliability optimization & assurance – Reliability's effect on medical devices – The concept of failure – Causes of failure – Types of Failures in Medical devices – Safety testing – Device specific safety goals, Failure assessment and Documentation, Electrical Safety – Biological aspect – Limitation of Voltages - Macroshock and Microshock – Earth and Protection – Leakage currents – Magnetic fields and compatibility	
TOTAL = 45 PERIODS	

TEXT BOOKS:

1. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada, Second edition, 2013
2. Richard Fries, "Reliable Design of Medical Devices – Second Edition", CRC Press, Taylor & Francis Group, 2006

REFERENCES :

1. J Norbert Leitgeb "Safety of Electro-medical Devices Law – Risks – Opportunities" Springer Verlog, 2010
2. NilsHoppe and Jose Miola, "Medical law and Medical Ethics", Cambridge University Press 2014

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17BMX14 – COMMUNICATION SYSTEMS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To apply analog modulation techniques.	1.1	The students will be able to apply analog modulation techniques.	**a,b,j,l**	
2.0	To gain knowledge on various receiver techniques.	2.1	The students will be able to learn various receiver techniques.	**a,b,d,g,j,l**	
3.0	To infer knowledge on various types coding techniques.	3.1	The students will be able to infer knowledge on various types of coding techniques.	**a,c**	
4.0	To know the various digital modulation techniques.	4.1	The students will be able to learn the digital modulation techniques.	**a,b,c,g,j,l**	
5.0	To analyze various error control coding techniques.	5.1	The students will be able to analyze various error control coding techniques.	**a,b,d,g**	

UNIT I – ANALOG MODULATION	**(9)**
Amplitude Modulation – AM, DSBSC, SSBSC, VSB – Angle Modulation – PM and FM – Modulators and Demodulators.	
UNIT II – RECEIVER CHARACTERISTICS	**(9)**
Noise Sources and Types – Noise Figure and Noise Temperature – Noise in Cascaded Systems – Single Tuned Receivers – Super Heterodyne Receivers.	
UNIT III – INFORMATION THEORY	**(9)**
Measure of Information – Entropy – Source Coding Theorem – Discrete Memoryless Channels – Lossless, Deterministic, Noiseless, BEC, BSC – Mutual Information – Channel Capacity – Shannon-Fano Coding, Huffman Coding, Run Length Coding, LZW Algorithm.	
UNIT IV – BANDPASS SIGNALING	**(9)**
Geometric Representation of Signals – Correlator and Matched Filter – ML Detection – Generation And Detection, PSD, BER of Coherent BPSK, BFSK, QPSK – Principles of QAM – Structure of non-coherent receivers – BFSK, DPSK.	

UNIT V – ERROR CONTROL CODING TECHNIQUES	(9)
Channel Coding Theorem – Linear Block Codes – Hamming Codes – Cyclic Codes (CRC) – Convolutional Codes – Viterbi Decoding (Soft/Hard Decision Decoding).	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems'', 3rd Edition, Oxford University Press, 2007.
2. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", 3rd Edition, TMH, 2007.
3. S. Haykin, "Digital Communications", John Wiley, 2005.

REFERENCES:

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

17BMX15 – MEDICAL OPTICS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To provide knowledge on the impact and properties of light.	**1.1**	The students will be able to acquire knowledge on the impact and properties of light.	**a,g**
2.0	To acquire knowledge of the fundamentals of optical properties of tissues.	**2.1**	The students will be able to demonstrate knowledge of the fundamentals of optical properties of tissues.	**a,b,d,h,l**
3.0	To describe surgical applications of laser.	**3.1**	The students will be able to describe surgical applications of laser.	**a,b,d,h,l**
4.0	To understand photonics and its therapeutic applications.	**4.1**	The students will be able to describe photonics and its therapeutic applications.	**a,b,c,g,l**
5.0	To learn the concepts of laser and light to understand the laser safety procedures.	**5.1**	The students will be able to apply the concepts of laser and light to understand the laser safety procedures.	**a,b,f,g**

UNIT I – INSTRUMENTATION IN PHOTONICS	**(9)**
Review of Basic Properties of Light – Reflection, Refraction, Scattering, Fluorescence and Phosphorescence. Instrumentation for Absorption, Scattering and Emission Measurements, Excitation Light Sources – High Pressure Arc Lamp, LEDs, Lasers. Optical Filters. Optical Detectors - Time Resolved and Phase Resolved Detectors, Optical Tweezers.	
UNIT II – OPTICAL PROPERTIES OF THE TISSUES	**(9)**
Light Transport Inside the Tissue, Optical Properties of Tissue. Laser Characteristics as applied to Medicine and Biology - Laser Tissue Interaction - Chemical, Thermal, and Electromechanical. Photo Ablative Processes.	
UNIT III – SURGICAL APPLICATIONS OF LASERS	**(9)**
Lasers in Ophthalmology - Dermatology – Dentistry – Urology – Otolaryngology - Tissue Welding.	
UNIT IV – NON-THERMAL DIAGNOSTIC APPLICATIONS	**(9)**
Optical Coherence Tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and Speckle Application of Lasers in Biology and Medicine.	

UNIT V – THERAPEUTIC APPLICATIONS	(9)
Phototherapy, Photodynamic Therapy (PDT) - Principle and Mechanism - Oncological and Non-oncological Applications of PDT - Biostimulation Effect – Applications - Laser Safety Procedures.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

17BMX16 – BODY AREA NETWORKS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To know about BAN network.	**1.1**	The students will be able to understand the importance and role of body area networks.	**a,f,g,l**
2.0	To know the hardware requirement of BAN.	**2.1**	The students will be able to design a BAN for appropriate application in medicine.	**a,b,c,d,f,g,h,j**
3.0	To understand the various communication standards.	**3.1**	The students will be able to analyze the various communication standards.	**a,f,g,j**
4.0	To understand the communication and security aspects in the BAN.	**4.1**	The students will be able to demonstrate the security aspects and the need for compliance with medical device regulations in different regions.	**a,b,d,f,g,h,**
5.0	To know the applications of BAN in the field of medicine.	**5.1**	The students will be able to match BAN concepts to medical applications.	**a,c,e,h**

UNIT I – INTRODUCTION BAN	**(9)**
Definition, BAN and Healthcare, Technical Challenges - Sensor Design, Biocompatibility, Energy Supply, Optimal Node Placement, Number of Nodes, System Security and Reliability, BAN Architecture – Introduction.	
UNIT II – HARDWARE FOR BAN	**(9)**
Processor - Low Power MCUs, Mobile Computing MCUs, Integrated Processor with Radio Transceiver, Memory, Antenna - PCB Antenna, Wire Antenna, Ceramic Antenna, External Antenna, Sensor Interface, Power Sources - Batteries and Fuel Cells for Sensor Nodes.	
UNIT III – WIRELESS COMMUNICATION AND NETWORK	**(9)**
RF Communication in Body, Antenna Design and Testing, Propagation, Base Station - Network topology – Stand-alone BAN, Wireless Personal Area Network Technologies - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.	
UNIT IV – COEXISTENCE ISSUES WITH BAN	**(9)**
Interferences – Intrinsic - Extrinsic, Effect on Transmission, Counter Measures - on Physical Layer and Data Link Layer, Regulatory Issues - Medical Device Regulation in USA and Asia, Security and Self-protection - Bacterial Attacks, Virus Infection, Secured Protocols.	

UNIT V – APPLICATIONS OF BAN	(9)
Monitoring Patients with Chronic Disease, Hospital Patients, Elderly Patients, Cardiac Arrythmias Monitoring, Multi patient Monitoring Systems, Multichannel Neural Recording, Gait Analysis, Sports Medicine, Electronic Pill.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.

REFERENCES:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2013.
2. Guang-ZhongYang, “Body Sensor Networks”, 2nd Edition, Springer, 2014.
3. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing, Singapore, 2012.

17BMX17 – MEDICAL WEARABLE DEVICES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand about the various sensors used for physiological system measurements.	**1.1**	The students will be able to describe various sensors used for measurements in physiological systems.	**a,f,l**
2.0	To gain knowledge about bio signal acquisition methods and signal processing methods for human systems.	**2.1**	The students will be able to understand the bio signal acquisition methods and signal processing methods for human systems.	**a,b.l**
3.0	To know the energy harvesting from various sources.	**3.1**	The students will be able to analyze the usage of optimized energy techniques for wearable devices.	**a,c,f,h,l**
4.0	To understand the affiliation of wireless communication and BAN in Tele health technology.	**4.1**	The students will be able to analyze the wireless communication and BAN in Tele health technology.	**a,c,d,f,g,h,j**
5.0	To understand various applications of wearable devices in Tele health technology.	**5.1**	The students will be able to infer the various applications of wearable systems.	**a,g,h,l**

UNIT I – SENSORS	**(9)**
Need for Wearable Systems, Sensors for Wearable Systems - Inertia Movement Sensors, Respiration Activity Sensor, Inductive Plethysmography, Impedance Plethysmography, Pneumography, Wearable Ground Reaction Force Sensor, GSR, Radiant Thermal Sensor, Wearable Motion Sensors, CMOS – Based Biosensors, E-Textiles, Bio compatibility.	
UNIT II – SIGNAL PROCESSING	**(9)**
Wearability Issues - Physical Shape and Placement of Sensor, Technical Challenges – Sensor Design, Signal Acquisition, Constraint on Sampling Frequency for Reduced Energy Consumption, Light Weight Signal Processing, Rejection of Irrelevant Information, Data Mining.	
UNIT III – ENERGY HARVESTING FOR WEARABLE DEVICES	**(9)**
Solar Cell, Vibration Based, Thermal Based, Human Body as a Heat Source for Power Generation, Hybrid Thermoelectric Photovoltaic Energy Harvests, Thermopiles.	

UNIT IV – WIRELESS HEALTH SYSTEMS	(9)
Need for Wireless Monitoring, Definition of Body Area Network, BAN and Healthcare, Technical Challenges - System Security and Reliability, BAN Architecture – Introduction, Wireless Communication Techniques.	
UNIT V – APPLICATIONS OF WEARABLE SYSTEMS	**(9)**
Medical Diagnostics, Medical Monitoring - Patients with Chronic Disease, Hospital Patients, Elderly Patients, Multi parameter Monitoring, Neural Recording, Gait Analysis, Sports Medicine, Smart Fabrics.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", AcademicPress, USA, 2014.
2. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

REFERENCES:

1. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.
2. Andreas Lymberis, Danilo de Rossi, “Wearable eHealth Systems for Personalized Health Management - State of the Art and Future Challenges”, IOS press, The Netherlands, 2004.
3. Hang,Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013.
4. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
5. Guang-ZhongYang, “Body Sensor Networks”, 2nd Edition, Springer, 2014.

17BMX18 – TELEMEDICINE AND MEDICAL IoT					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To learn the key principles for telemedicine and multimedia technologies in telemedicine.	**1.1**	The students will be able to understand the key principles for telemedicine and multimedia technologies in telemedicine.	**a,f,g,h,j**	
2.0	To know telemedical standards.	**2.1**	The students will be able to demonstrate telemedical standards.	**a,f,g,j**	
3.0	To understand telemedical technology and mobile telemedicine	**3.1**	The students will be able to discuss telemedical technology and mobile telemedicine.	**a,b,d,f,g,j,l**	
4.0	To understand aspects of IoT in telemedicine.	**4.1**	The students will be able to understand the various aspects of IoT in telemedicine.	**a,d,e,g,j**	
5.0	To gain knowledge on application of telehealth in healthcare.	**5.1**	The students will be able to analyze the applications of telehealth in healthcare.	**a,g,h,l**	

UNIT I – TELEMEDICAL TECHNOLOGY	**(9)**
Evolution of Telemedicine, Functional Diagram of Telemedicine System, Telemedicine, Telehealth, Tele care, Organs of Telemedicine, Principles of Multimedia, PSTN, POTS, ANT, ISDN, Internet, Air/ Wireless Communications, Types of Antenna, Integration and Operational Issues, Communication Infrastructure for Telemedicine. Mobile Hand Held Devices and Mobile Communication. Internet Technology and Telemedicine using World Wide Web (www). Clinical Data – Local and Centralized.	
UNIT II – TELEMEDICAL STANDARDS	**(9)**
Data Security and Standards - Mechanisms of Encryption, Phases Of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine Integrating Doctors / Hospitals, Clinical Laboratory Data, Radiological Data, and Other Clinically Significant Biomedical Data, Administration of Centralized Medical Data, Security and Confidentially of Medical Records and Access Control, Cyber Laws related to Telemedicine.	
UNIT III – MOBILE TELEMEDICINE	**(9)**
Tele radiology: Definition, Basic parts, Tele pathology, Multimedia Databases, Color Images Of Sufficient Resolution, Dynamic Range, Spatial Resolution, Compression Methods, Interactive Control of Color, Medical Information Storage and Management for Telemedicine - Patient Information Medical History, Test Reports, Medical Images Diagnosis and Treatment. Hospital Information System - Doctors, Paramedics, Facilities Available. Pharmaceutical Information System.	

UNIT IV – INTRODUCTION TO IoT	(9)
Introduction to Internet of Things (IoT). Review of CC3200 Core and its Architecture, Introduction to Advanced ARM Cortex M4 Architecture, Peripherals Overview, User API, Power Challenges with IoT, CC3200 Simple Link Applications, Starting with Code Composer Studio V6. Various Wireless Protocols and its Applications: ZigBee, Bluetooth Low Energy, 6LowPAN, Wi-Fi.	
UNIT V – APPLICATIONS OF TELEHEALTH TECHNOLOGY	**(9)**
Telemedicine Access to Health Care Services – Health Education and Self-care - Introduction to Robotics Surgery, Telesurgery, Telecardiology, Teleoncology, Telemedicine in Neurosciences - Electronic Documentation - e-health Services - Security and Interoperability - Telemedicine Access to Health Care Services - Introduction to WLAN, WLAN Parameters, AP/STATION Modes and its Security Types, Socket Connection, WLAN AP and WLAN STATION Configuration Settings.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. R.S.Khandpur, "Telemedicine Technology and Applications (mhealth, Telehealth and ehealth)", PHI Learning Pvt. Ltd., Delhi, 2017.
2. Wootton, R., Craig, J., Patterson, V., "Introduction to Telemedicine", Royal Society of Medicine Press Ltd., Taylor & Francis 2006.

REFERENCES:

1. Latifi, R, "Current Principles and Practices of Telemedicine and e-Health", IOHS Press, Washington DC, 2008.
2. Bashshur, R.L., Shannon G.W., "History of Telemedicine", New Rochelle NY: Mary Ann Liebert Publishers, 2009.
3. Victor Lyuboslavsky, "Telemedicine and Telehealth 2.0: A Practical Guide for Medical Providers and Patients", 1st Edition, CreateSpace Independent Publishing Platform, 2015.

17BMX19 – MEDICAL INFORMATICS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To teach ICT applications in medicine with an introduction to health informatics.	**1.1**	The students will be able to discuss about health informatics and different ICT applications in medicine.	**a,c,e,g,l**	
2.0	To understand the theories and practices adopted in Hospital Information Systems in the light of medical standards.	**2.1**	The students will be able to appreciate and adopt medical standards.	**a,f,h**	
3.0	To know medical data formats and recent trends in Hospital Information systems for data acquisition and storage.	**3.1**	The students will be able to recognize medical data formats and recent trends in Hospital Information systems for data acquisition and storage.	**a,b,c,e,f,h,l**	
4.0	To introduce the basics of bioinformatics, resources in the field and to apply the standards in proper health care delivery.	**4.1**	The students will be able to understand the basics of bioinformatics, resources in the field and the standards in proper health care delivery.	**a,c,f,h**	
5.0	To understand the recent trends in medical informatics.	**5.1**	The students will be able to discuss the recent trends in medical informatics.	**a,b,c,e,g,h,l**	

UNIT I – MEDICAL INFORMATICS	**(9)**
Introduction - Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics – Functional Capabilities of Hospital Information System - On-line Services and Off – Line Services - History taken by Computer, Dialogue with the Computer.	
UNIT II – MEDICAL STANDARDS	**(9)**
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.	
UNIT III – MEDICAL DATA ACQUISITION AND STORAGE	**(9)**
Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface - Medical Data Formats – Signal, Image and Video Formats – Medical Data bases - Automation in Clinical Laboratories - Intelligent Laboratory Information System - PACS , Data mining.	

UNIT IV – HEALTH INFORMATICS	(9)
Bioinformatics Databases, Bio-information Technologies, Semantic Web and Bioinformatics, Genome Projects, Clinical Informatics, Nursing Informatics, Public Health Informatics - Education and Training.	
UNIT V – RECENT TRENDS IN MEDICAL INFORMATICS	**(9)**
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment - Surgical simulation – Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. R. D. Lele, "Computers in Medicine: Progress in Medical Informatics'', Tata McGraw Hill Publishing Computers Ltd., New Delhi, 2005.
2. Mohan Bansal, "Medical Informatics", Tata McGraw Hill Publishing Computers Ltd., New Delhi, 2003.

REFERENCES:

1. Mathivanan.N, "PC-Based Instrumentation'', Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2. Yi – Ping Phoebe Chen, "Bioinformatics Technologies'', Springer International Edition, New Delhi, 2007.
3. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University Press, 2007.

17BMX20 – HOSPITAL PLANNING, ORGANIZATION AND MANAGEMENT				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To learn about the sole proprietorship and partnership to the principles of management and evolution.	**1.1**	The students will be able to understand the sole proprietorship and partnership to the principles of management and evolution.	**f,h,i,k**
2.0	To know about the importance of hospital management and the process of forecasting techniques and decision-making process.	**2.1**	The students will be able to learn the importance of hospital management and the process of forecasting techniques and decision-making process.	**f,g,h,i,k**
3.0	To understand the pattern of staffing, selection and recruiting process to the training of organizational and career development.	**3.1**	The students will be able to discuss the pattern of staffing, selection and recruiting process to the training of organizational and career development.	**f,h,i,j,k**
4.0	To infer knowledge on the basic marketing in health sector with a principle to social marketing.	**4.1**	The students will be able to analyze the basic marketing in health sector with a principle to social marketing.	**b,d,h,i,j**
5.0	To know about system development of life cycle and main categories of information systems in hospital.	**5.1**	The students will be able to gain knowledge on the system development of life cycle and main categories of information systems in hospital.	**d,e,h**

UNIT I – FORMS OF ORGANISATION	**(9)**
Sole Proprietorship, Partnership, Company-public and Private Sector Enterprises, Principles of Management, Evolution of Management.	
UNIT II – PRINCIPLE OF HOSPITAL MANAGEMENT	**(9)**
Importance of Management and Hospital, Management Control Systems. Forecasting Techniques Decision-making Process.	
UNIT III – STAFFING	**(9)**
Staffing Pattern in Hospitals, Selection, Recruiting Process, Training of Staff, Organizational Structures, Career Development.	

UNIT IV – MARKETING AND MANAGEMENT	(9)
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.	
UNIT V – COMPUTER IN HOSPITAL	**(9)**
System Development Life Cycle, Reasons to use Computers in Hospital, Main Categories of Information Systems in Hospitals.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. G. D. Kunders, "Hospitals: Facilities Planning and Management", Tata Mc Graw Hill Education, New Delhi, 2004.
2. Goyal R.C., "Human Resource Management in Hospital", Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

REFERENCES:

1. Nauhria R.N. and Rajnish Prakash, "Management & Systems", New Delhi Wheeler Publishing, 1995.
2. Syed Amin Tabish, "Hospitals & Nursing Homes: Planning, Organisations & Management", Jaypee Brothers Medical Publishers (P) Limited, 2003.

17BMX21 – FINANCE MANAGEMENT IN HOSPITALS					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To learn the scope and goal of financial management.	**1.1**	The students will be able to understand the scope and goal of financial management.	**b,d,f,h,k**	
2.0	To infer knowledge on the basic principles and processes involved in the accounting.	**2.1**	The students will be able to discuss on the basic principles and processes involved in the accounting.	**b,d,f,h,k**	
3.0	To develop skills in analyzing various technical and analytical tools for accounting.	**3.1**	The students will be able to interpret the skills used for analyzing various technical and analytical tools for accounting.	**a,b,c,e,h,k**	
4.0	To understand the basic budgetary control in cost and volume with profit analysis.	**4.1**	The students will be able to analyze the basic budgetary control in cost and volume with profit analysis.	**b,d,h,k**	
5.0	To enhance skills in decision-making in a hospital setting and practice the preparation of final accounts.	**5.1**	The students will be able to come up with ideas on decision-making in a hospital setting and practice the preparation of final accounts.	**c,f,h,k**	

UNIT I – INTRODUCTION	**(9)**
Finance Function – Meaning – Definition - Scope of Finance Function- Executive Functions & Incidental Functions - Scope and Goal of Financial Management in Hospitals – Profit Maximization & Wealth Maximization.	
UNIT II – ACCOUNTING TECHNIQUES	**(9)**
Types of Accounting, Hospital Accounting - Financial Book Keeping, Book Keeping Obligations. Accounting Concepts & Conventions – Final Accounts: Trading – Profit & Loss Accounts - Balance Sheet.	
UNIT III – COSTING IN HOSPITALS	**(9)**
Nature & Scope of Cost Accounting – Cost Analysis & Classification - Cost Calculation, Significance of Internal Billing in Hospital - Necessary for Internal & External Controlling Cost, Cost Unit Calculation.	

UNIT IV – MANAGEMENT ACCOUNTING	(9)
Budgeting & Budgetary control – Cost – Volume – Profit Analysis.	
UNIT V – FINANCING DECISIONS	**(9)**
Cost of Capital & Capital Structure – Sources of Short Term Finance: Management of Working Capital – Sources of Long Term Finance: Share Capital, Debentures - Corporate Debit Capacity.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. G R Kulkarni, P Satyashankar, Libert Anil Gomes, "Financial Management for Hospital", 2009.
2. I M Pandey Vikas, "Financial Management", Publishing Co., 1999.
3. Jaypee Brothers "Administration", Medical Publishers Pvt. Limited, 01-Jul-2009.

REFERENCES:

1. James C.Vanhorne, "Financial Management and Policy", 9th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
2. Michael Nowicki, "The Financial Management of Hospitals and Healthcare Organizations", Health Administration Press, 2008.
3. Prasanna Chandra, "Financial Management", 1st Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

17BMX22 – HUMAN RESOURCES MANAGEMENT IN HOSPITAL					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To know about the evolution of human resource management.	**1.1**	The students will be able to learn the evolution of human resource management.	**b,f,h**	
2.0	To infer knowledge on the organisational job design and the forecasting of human resource requirements.	**2.1**	The students will be able to recognize the organisational job design and the forecasting of human resource requirements.	**c,h,j**	
3.0	To be studious on the type of training method in the executive development programme.	**3.1**	The students will be able to discuss the training method in the executive development programme.	**f,h**	
4.0	To encompass the strategy of employee sustainability.	**4.1**	The students will be aware of the employee sustainability strategy.	**f,g,h**	
5.0	To acquaint various methods involved in performance appraisal.	**5.1**	The students will be able to narrate the various methods involved in performance appraisal.	**b,g,h**	

UNIT I – PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT	**(9)**
Evolution of Human Resource Management - Importance of Human Factor, Objectives of Human Resource Management - Human Resource Policies - Need for HRD/HRM in Healthcare Organization - Computer Applications in Human Resource Management.	
UNIT II – THE CONCEPT OF BEST FIT EMPLOYEE	**(9)**
Organizational Job Design - Job Description - Job Analysis - Job Rotation-job Evaluation- Man-power Planning-Importance of Human Resource Planning, Forecasting of Human Resource Requirements - Selection Procedures - Test, Validation, Interviews, Recruitment, Medical Examination.	
UNIT III – TRAINING & EXECUTIVE DEVELOPMENT	**(9)**
Types of Training Methods and their Benefits - Executive Development Programme – Common Practices - Benefits, Self-development - Knowledge Management.	
UNIT IV – SUSTAINING EMPLOYEE INTEREST	**(9)**
Wage and Salary Administration – Concept of Incentives and its Operational Implications – Participative Decision making – Concept of Collective Bargaining – Compensation Plans – Rewards – Motivation – Theories of Motivation - Grievances and Redressal Methods.	

UNIT V – PERFORMANCE APPRAISAL	(9)
Importance of Performance Appraisal - Methods of Performance Evaluation - Traditional Methods – Modern Methods – Feedback – Promotion – Demotion – Transfer. Implications of Job Change. The Control Process, Methods and Requirements of Effective Control System.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. D. K. Sharma, R. C. Goyal, "Hospital Administration and Human Resource Management", PHI Learning Pvt. Ltd., 2013.
2. Decenzo and Robbins, "Human Resource Management", Wiley & Sons, Singapore, 1999.

REFERENCES:

1. Mamoria C.B. and Mamoria S., "Personnel Management", Himalaya Publishing Company, 1997.
2. R.C.Goyal, "Human Resource Management in Hospitals", Prentice Hall of India, 2000.
3. Walter J. Flynn, Robert L. Mathis, John H. Jackson, "Healthcare Human Resource Management", 2006.

17BMX23 – HOSPITAL ARCHITECTURE					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To gain knowledge on various framework and structure of health care system.	**1.1**	The students will be able to analyze the various framework and structure of health care system.	**a,c,e,f,h**	
2.0	To know all the facets of hospital planning.	**2.1**	The students will be able to familiar with all the facets of hospital planning.	**a,c,d,g,h,i**	
3.0	To learn the newest findings in the area of hospital planning.	**3.1**	The students will be able to interpret the newest findings in the area of hospital planning.	**a,c,d,g,h,i,l**	
4.0	To implement the perspectives in constructing hospital standards.	**4.1**	The students will be able to discuss the perspectives in constructing hospital standards.	**a,c,g,h**	
5.0	To be studious in hospital planning activities covering every department.	**5.1**	The students will be enlightened in hospital planning activities covering every department.	**a,c,g,h,k**	

UNIT I – INTRODUCTION TO HEALTH CARE SYSTEM	**(9)**
International and National Level Policy Framework for Healthcare Facilities – Types of Healthcare Facilities based on Public and Private Ownership, Bed Size and Type of Health Care Services based on Outpatient, Inpatient and Diagnostic Care - Organizational, Function and Structure of the Hospital.	
UNIT II – HOSPITAL PLANNING	**(9)**
Principles of Planning, Regionalization, Hospital Planning Team, Planning Process, Size of the Hospital, Site Selection, Hospital Architect, Architect Report, Equipping a Hospital, Interiors & Graphics, Construction & Commissioning, Planning for Preventing Injuries, Electrical Safety.	
UNIT III – PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS	**(9)**
Planning and Designing of Administrative Services, Medical and Ancillary Services, Nursing Services, Supportive Services, Public Areas and Staff Services, Hospital Services of Training Methods and their Benefits - Executive Development Programme – Common Practices - Benefits, Self-development - Knowledge Management.	
UNIT IV – STANDARDS AND NORMS FOR HOSPITALS	**(9)**
Design and Construction Standards for the Hospitals namely BIS – India and JCAHO, AIA and NHS – General Guidelines and Standard for Out-patient Area, In-patient Area and Diagnostic Area in the Hospitals. Voluntary & Mandatory Standards, General Standards, Mechanical Standards, Electrical Standards, Standard for Centralized Medical Gas System, Standards for Biomedical Waste.	

UNIT V – FACILITIES FOR SUPPORTIVE SERVICES	(9)
Transport, Information System, Communication, Food Services, Mortuary, Heating Ventilation and Air Conditioning, Medical Gases, House Keeping, Laundry.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. G.Kunders, “Hospitals - Facilities Planning & Management”, Tata McGraw - Hill Education, 2004.
2. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra, “Step by Step Hospital Designing and Planning”, 2nd Edition, Jaypee Brothers-Medical Publishers, New Delhi, 2010.

REFERENCES:

1. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy, “Modern trends in Planning and Designing of Hospitals: Principles and Practice”, Jaypee Brothers-Medical publishers, New Delhi, 2007.
2. Sa Tabish, “Hospital and Nursing Homes Planning, Organisation and Management”, Jaypee Brothers-Medical Publishers, New Delhi, 2003.

17BMX24 – HEALTH POLICY AND EQUIPMENT MANAGEMENT

	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To learn about the various health care systems.	**1.1**	The students will be able to interpret on the various health care systems.	**e,f,h**
2.0	To infer knowledge on various health policies.	**2.1**	The students will be able to analyze various health policies.	**b,f,h**
3.0	To introduce the equipment maintenance management skills.	**3.1**	The students will be able to learn the equipment maintenance management skills.	**a,c,f,g,h**
4.0	To enlighten students on logistics support and reliability required for hospitals.	**4.1**	The students will be able to understand about the logistics support and reliability required for hospitals.	**f,h,k**
5.0	To protect equipment from electromagnetic interferences.	**5.1**	The students will be able to identify and restore equipment from electromagnetic interferences.	**a,b,c,g**

UNIT I – HEALTH SYSTEM	**(9)**
Health Organization of the Country, the State and Cities, Health Financial System, Teaching cum Research Hospitals, General Hospital, PHC Reference System, Ambulatory Care.	
UNIT II – NATIONAL HEALTH POLICY	**(9)**
Need for Evaluating a Health Policy, Need for providing Primary Health Care, Health Education, Health Insurance, Health Legislation, Inter Sectoral Co-operation.	
UNIT III – EQUIPMENT MAINTENANCE MANAGEMENT	**(9)**
Organizing the Maintenance Operation, Biomedical Equipment Procurement Procedure, Proper Selection, Compatibility, Testing and Installation, Purchase and Contract Procedure, Trained Medical Staff, Proper use of Equipment and Operating Instructions. Maintenance Job Planning, Preventive Maintenance, Maintenance Budgeting, Contract Maintenance.	
UNIT IV – LOGISTIC SUPPORT & RELIABILITY	**(9)**
Maintenance Equipment and Tools, Failure Analysis, Spare Parts and Maintenance Materials. Reliability Fundamentals.	

UNIT V – EMI IN HOSPITAL EQUIPMENTS	(9)
Principles of EMI, Computation of EMI, Method of Suppressing and Isolating the Unit from Interference.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Antony Kelly, "Maintenance Planning & Control", Butterworth, London 1984.
2. Binseng Wang, "Medical Equipment Maintenance: Management and Oversight", Morgan & Claypool Publishers, 2012.

REFERENCES:

1. Hans Pleiff Veradammann, "Hospital Engineering in Developing Countries", First edition, GTZ Report Eschborn, 1986.
2. Keith Willson, Keith Ison, Slavik Tabakov, "Medical Equipment Management", CRC Press, 2013.
3. R. C. Goyal, "Human Resource Management in Hospitals", Prentice Hall of India, New Delhi, 2000.

17BMX25 – HOSPITAL WASTE MANAGEMENT					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To infer knowledge on the importance of waste disposal.	**1.1**	The students will be able to understand the importance of waste disposal.	**a,b,g,h**	
2.0	To understand the various sterilization methods.	**2.1**	The students will be able to recognize the various sterilization methods.	**a,d,g,h**	
3.0	To discuss health care waste management.	**3.1**	The students will be able to implement health care waste management.	**a,d,g,h,k**	
4.0	To understand the controls applied to waste management.	**4.1**	The students will be able to realize the controls applied to waste management.	**a,d,g,h,l**	
5.0	To prevent environmental pollution and ensure safety.	**5.1**	The students will be able to analyze the causes of environmental pollution and ensure safety.	**a,b,c,d,g,h**	

UNIT I – HOSPITAL WASTE	**(9)**
Definition. Classification, Categories, Sources. Routes. Associated Diseases, Risks, Control of Hazards, Associated Problems in India; Need, Objective and Importance of Bio Medical Waste Management Programme in Health Care Facilities; Steps in Management of BMW.	
UNIT II – CONTROL OF HOSPITAL ACQUIRED INFECTION	**(9)**
Types of Infection; Common Nosocomial Infection and their Causative Agents; Prevention of Hospital Acquired Infection; Role of Central Sterile Supply Department; Infection Control Committee; Monitoring and Control or Cross-Infection; Staff Health.	
UNIT III – BIOMEDICAL WASTE MANAGEMENT	**(9)**
Meaning, Categories of Biomedical Wastes; Disposal of Biomedical Waste Products; Incineration and its Importance; Standards for Waste Autoclaving, Micro Waving and Deep Burial; Segregation, Packaging, Transportation and Storage.	
UNIT IV – HUMAN WASTE DISPOSAL AND SEWAGE DISPOSAL	**(9)**
Diseases carried from Excreta; Sanitation Barrier; Methods of Excreta Disposal; Sewage Wastes: Meaning, Composition; Aims of Sewage Disposal; Decomposition of Organic Matter; Modern Sewage Treatment; Drawbacks of Improper Disposal of Wastes; Solid and Liquid Waste Disposal.	

UNIT V – SAFETY AND PROTECTIVE MEASURE	(9)
Principles of Safe Handling; Personal Protective Devices and other Protective Measures; Occupational Safety; Training for Doctors, Nurses, Nodal Officers and Waste Management Analyzers.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Anantpreet Singh & Kaur Sukhjit, "Bio-medical waste disposal", Jaypee Brothers Medical Publishers Pvt. Ltd, 2012.

REFERENCES:

1. Bahera. P.K, "Sustainable Bio-medical Waste Management", Dominant Publishers & Distributors, 2009.
2. Sharma, "Holistic Approach to Hospital Waste Management", Department of Hospital Administration – AIIMS, New Delhi, 2006.

17BMM01 – INTRODUCTION TO BIOMEDICAL ENGINEERING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To interpret the role of biomedical engineering in society.	**1.1**	Students will be able to interpret the role of biomedical engineering in society.	**a,f,i**
2.0	To demonstrate the principles of various diagnostic devices.	**2.1**	Students will be able to demonstrate the principles of various diagnostic devices.	**a,c,g**
3.0	To identify the various techniques used in diagnosis though imaging.	**3.1**	Students will be able to identify the various techniques used in diagnosis though imaging.	**a,b,c,g**
4.0	To describe the working principles of various therapeutic and assist devices.	**4.1**	Students will be able to describe the working principles of various therapeutic and assist devices.	**a,b,g,h**
5.0	To understand device specific safety goals and standards.	**5.1**	Students will be able to understand device specific safety goals and standards.	**a,b,g**

UNIT I – INTRODUCTION	**(9)**
Historical Perspective - Evolution of Modern Healthcare System - Modern Healthcare System - Role of Biomedical Engineers in various Domain - Recent Advances in Biomedical Engineering - Professional Status of Biomedical Engineering - Professional Societies for Biomedical Engineering.	
UNIT II – FUNDAMENTALS OF MEDICAL INSTRUMENTATION	**(9)**
Anatomy and Physiology – Sources of Biomedical Signals- Basic Medical Instrumentation System - Performance Requirements – Intelligent Medical Instrumentation Systems - PC based Medical Instruments - General Constraints in Design of Medical Instruments.	
UNIT III – DIAGNOSTIC IMAGING	**(9)**
X-rays, Nuclear Medical Imaging - Positron Emission Tomography - Magnetic Resonance Imaging Scanners - Diagnostic Ultrasound - Thermal Imaging Systems.	
UNIT IV – INTRODUCTION TO BIOMEDICAL EQUIPMENT	**(9)**
ECG - EEG - Cardiac Pacemakers - Cardiac Defibrillators – Haemodialysis Machines - Artificial Kidney – Dialyzers – Ventilators - Humidifiers, Nebulizers and Aspirators - Anaesthesia Machine.	

UNIT V – MEDICAL SAFETY STANDARDS	(9)
Medical Standards and Regulations – Institutional Review Boards – Good Laboratory Practices - Good Manufacturing Practices - Human Factors.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. Enderle, John D, Bronzino, Joseph D, Blanchard, Susan M, "Introduction to Biomedical Engineering", 2nd Edition, Elsevier Inc, 2005.
2. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 2nd Edition, McGraw-Hill Publishing Company Limited, 2003.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", 2nd Edition, Prentice Hall of India, New Delhi, 2002.

REFERENCES:

1. John G Webster, "Medical Instrumentation: Application and Design", 4th Edition, John Wiley and Sons, New York, 2010.
2. Daniel A Vallero, "Biomedical Ethics for Engineers", 1st Edition, Elsevier Publication, 2007
3. Joseph. J Carr, John M Brown, "Introduction to Biomedical Equipment Technology", 4th Edition, John Wiley & Sons, New York, 2008.
4. Norbert Leitgeb, "Safety of Electro-medical Devices - Risks Opportunities", Springer-Verlag/Wein, 2010.
5. Michael Domach "Introduction to Biomedical Engineering", Pearson, 2004.

17BMM02 – BIO PHYSICS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To impart knowledge on the fundamentals of light.	**1.1**	Students will be able to be familiar with the fundamentals of light.	**a,g**
2.0	To assess the significance of sound in medicine.	**2.1**	Students will be able to learn the significance of sound in medicine.	**a,c,g**
3.0	To comprehend radioactive nuclides.	**3.1**	Students will be able to understand radioactive nuclides.	**a,g**
4.0	To outline the interaction of radiation with matter.	**4.1**	Students will be able to narrate the interaction of radiation with matter.	**a,f,g**
5.0	To understand the applications of light, sound and radiation in medicine.	**5.1**	Students will be able to interpret the applications of light, sound and radiation in medicine.	**a,f,g**

UNIT I – NON IONIZING RADIATION	**(9)**
Non-ionizing Electromagnetic Radiation: Overview of Non-ionizing Radiation Effects - Electromagnetic Spectrum - Low Frequency Effects - Higher Frequency Effects. Physics of Light, Measurement of Light and its Unit - Limits of Vision and Color Vision, Thermography – Fundamentals of Near Infrared Spectroscopy.	
UNIT II – SOUND IN MEDICINE	**(9)**
Physics of Sound, Normal Sound Levels – Ultrasound Fundamentals – Generation of Ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with Matter; Cavitations, Reflection, Transmission - Scanning Systems – Artifacts – Ultrasound - Doppler Shift.	
UNIT III – PRINCIPLES OF RADIOACTIVE NUCLIDES	**(9)**
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma Ray Emission, Alpha, Beta, Positron Decay, Electron Capture, Sources of Radioisotopes Natural and Artificial Radioactivity, Decay Series, Production of Radionuclides – Cyclotron produced Radionuclide - Reactor produced Radionuclide - Fission and Electron Capture Reaction, Radionuclide Generator -Technetium Generator.	
UNIT IV – INTERACTION OF RADIATION WITH MATTER	**(9)**
Interaction of Charged Particles with Matter – Specific Ionization, Linear Energy Transfer Range, Bremsstrahlung, Annihilation, Interaction of X and Gamma Radiation with Matter- Photoelectric Effect, Compton Scattering, Pair Production, Attenuation of Gamma Radiation ,Interaction of Neutron with Matter and their Clinical Significance.	

UNIT V – CLINICAL APPLICATIONS	(9)
Thermography Applications - Clinical Applications of Doppler – Applications of Gamma radiation in Medicine - Radionuclide used in Medicine and Technology.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS:

1. John R Cameran, James G Skofronick, “Medical Physics”, John-Wiley & Sons Publications, 2002.
2. W.J. Meredith and J.B. Massey, “Fundamental Physics of Radiology”, Varghese Publishing House, 2011.

REFERENCES:

1. S. Webb, “The Physics of Medical Imaging”, Taylor and Francis, 2013.
2. J. P. Woodcock, “Ultrasonic Medical Physics Handbook Series”, Adam Hilger, Bristol, 2002.
3. Hylton B. Meire and Pat Farrant, “Basic Ultrasound”, John Wiley & Sons, 1994.

17BMM03 – BIOMEDICAL SENSORS

	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To identify the calibration procedure for the basic instruments involved in physiological parameter measurement.	**1.1**	Students will be able to identify the calibration procedure for the basic instruments involved in physiological parameter measurement.	**a,b,h**
2.0	To develop medical sensors based on the basic transduction principles.	**2.1**	Students will be able to develop medical sensors based on the basic transduction principles.	**a,b,c,e,g**
3.0	To understand the various medical sensor for a particular application.	**3.1**	Students will be able to analyze the various medical sensors.	**a,b,c,g**
4.0	To comprehend the various bio chemical sensor for a particular application.	**4.1**	Students will be able to analyze the various bio chemical sensors.	**a,b,c,g**
5.0	To understand the various bio potential electrodes	**5.1**	Students will be able to analyze the working of various bio potential electrodes	**a,b,c,d**

UNIT I – SCIENCE OF MEASUREMENT	**(9)**
Generalized Instrumentation System, General Properties of Input Transducer. Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance. Dynamic Characteristics: First Order and Second Order Characteristics, Time Delay, Transfer Function – First and Second Order Systems.	
UNIT II – DIFFERENT TRANSDUCTION PRINCIPLE	**(9)**
Temperature Transducers - Thermo Resistive Transducers, Thermoelectric, Displacement Transducers - Potentiometric, Resistive Strain Gauges, Inductive Displacement, and Capacitive Displacement Transducer. Pressure Transducer - Indirect Method - Measurement of Blood Pressure using Sphygmomanometer, Piezo-electric Type, Catheter Tip Transducers, Measurement of Intracranial Pressure, Catheter Tip - Implantable Type.	
UNIT III – BIO SENSORS	**(9)**
Electrolytic Sensors, Optical Sensor, Fiber Optic Sensors. Biosensors in Clinical Chemistry, Medicine and Health Care.	

UNIT IV – BIO CHEMICAL SENSORS	(9)
Introduction, Advantages and Limitations, Various Components of Biosensors, Biocatalysts based Biosensors, Bio-affinity based Biosensors & Microorganisms based Biosensors, Types of Membranes used in Biosensor Constructions.	
UNIT V – BIO POTENTIAL ELECTRODES	**(9)**
Electrodes Electrolyte Interface, Half Cell Potential, Polarization, Polarizable and Non Polarizable, Electrodes, Calomel Electrode, Electrode Circuit Model, Electrode Skin-Interface and Motion Artifact. Body Surface Electrodes. Ion Exchange Membrane Electrodes, Oxygen Electrodes, CO2 Electrodes Enzyme Electrode, ISFET for Glucose, Urea.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation-Application and Design", 2013.
2. Richard S.C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications", John Wiley & Sons, 2004.

REFERENCES:

1. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation", 2nd Edition, PHI 2013.
2. Hermann K P. Neubert, "Instrument Transducer – An Introduction to their Performance and Design", 1975.

17BMM04 – ANALYTICAL INSTRUMENTATION					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To identify various techniques and methods of analysis which occur in the various regions of the spectrum.	**1.1**	Students will be able to analyze various techniques and methods in the various regions of the spectrum.	**a,b,d,g**	
2.0	To learn the unique methods of separation of closely similar materials.	**2.1**	Students will be able to understand the chromatography methods of separation of closely similar materials.	**a,b,f**	
3.0	To outline the important analytical methods of industrial gases.	**3.1**	Students will be able to interpret the important analytical methods of industrial gases.	**a,b,d,e,g**	
4.0	To discuss the principle involved in pH and dissolved component analyzers.	**4.1**	Students will be able to understand the principle involved in pH and dissolved component analyzers.	**a,b,e,g**	
5.0	To illustrate the various methods involving electromagnetic resonance.	**5.1**	Students will be able to discuss on the various methods involving electromagnetic resonance.	**a,b,d,g**	

UNIT I – COLORIMETRY AND SPECTROPHOTOMETRY	**(9)**
Significance of Invitro Diagnostics - Special Methods of Analysis – Beer-Lambert Law – Colorimeters – UV-Visible Spectrophotometers – Single and Double Beam Instruments – Sources and Detectors – IR Spectrophotometers – Types – Attenuated Total Reflectance Flame Photometers – Atomic Absorption Spectrophotometers – Sources and Detectors – FTIR Spectrophotometers – Flame Emission Photometers – Fluorescence Spectrophotometer.	
UNIT II – CHROMATOGRAPHY	**(9)**
Different techniques – Gas chromatography – Detectors – Liquid chromatographs – Applications – High-pressure liquid chromatographs – Applications.	
UNIT III – GAS ANALYZERS	**(9)**
Types of Gas Analyzers – Oxygen, NO2 and H2S Types, IR Analyzers, Thermal Conductivity Analyzers, Analysis based on Ionization of Gases.	

UNIT IV – pH METERS AND DISSOLVED COMPONENT ANALYZERS	(9)
Principle of pH Measurement, Glass Electrodes, Hydrogen Electrodes, Reference Electrodes, Selective Ion Electrodes, Ammonia Electrodes, Cyclic Voltametry, Biosensors, Dissolved Oxygen Analyzer – Sodium Analyzer – Silicon Analyzer.	
UNIT V – ELECTRO MAGNETIC RESONANCE	**(9)**
NMR – Basic Principles – NMR Spectrometer - Applications. Electron Spin Resonance Spectroscopy – Basic Principles, Instrumentation and Applications.	
	TOTAL (L: 45) = 45 PERIODS

TEXT BOOK:

1. R.S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 2007.
2. Sivasankar, "Instrumental Methods of Analysis", Oxford University Press India, 2012.

REFERENCES:

1. Robert D. Braun, "Introduction to Instrumental Analysis", McGraw Hill, Singapore, 1987.
2. Liptak, B.G, "Process Measurement and Analysis", Chilton Book Company, 1995.
3. G.W. Ewing, "Instrumental Methods of Analysis", McGraw Hill, 1992.
4. R.K.Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.
5. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, "Instrumental Methods of Analysis", CBS Publishing & Distribution, 1995.

17BMM05 – RADIATION AND NUCLEAR MEDICINE				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To acquire knowledge about radiation activity in the living cells.	**1.1**	Students will be able to acquire knowledge about radiation activity in the living cells.	**a,b,d,g,h**
2.0	To identify the key principles of nuclear medicine and radioactivity.	**2.1**	Students will be able to identify the key principles of nuclear medicine and radioactivity.	**a,b,c,f,g,h**
3.0	To analyze the working principle of advanced nuclear medicine imaging systems.	**3.1**	Students will be able to analyze the working principle of advanced nuclear medicine imaging systems.	**a,b,c,e,f,g,h**
4.0	To interpret the effects of ionizing and non-ionizing radiations.	**4.1**	Students will be able to interpret the effects of ionizing and non-ionizing radiations.	**a,b,d,g**
5.0	To analyze the effect of microwave on human organs and systems.	**5.1**	Students will be able to analyze the effect of microwave on human organs and systems.	**a,b,c,f,g,h**

UNIT I – ACTION OF RADIATION IN LIVING CELLS	**(9)**
Various Theories related to Radiation at Cellular Level - DNA and Chromosomal Damages - Somatic Application of Radiation - Radio Sensitivity Protocols of different Tissues of Human - Ld50/30 Effective Radiation on Skin, Bone Marrow, Eye, Endocrine Glands, and Basis of Radio Therapy.	
UNIT II – NUCLEAR MEDICINE	**(9)**
Basic Characteristic and Units of Radioactivity, Ionization Chamber, GM Tubes, Gas Filled Detectors, Scintillation Detectors, Semiconductor Detectors, Liquid Scintillation Counter, Statistical Aspects of Nuclear Medicine.	
UNIT III – NUCLEAR MEDICINE IMAGING SYSTEMS	**(9)**
Rectilinear Scanners, Scintillation Camera, Principle of Operation, Collimator, Photomultiplier Tube, Pulse Height Analyser, Computerized Multi Crystal Gamma Camera, Principles of PET and SPECT.	
UNIT IV – RADIATION THERAPY	**(9)**
Principles of Radiation Therapy, Radio Therapy Treatment Planning Dose in Radiotherapy, Mega Voltage Therapy, Intensity Modulated Radiation Therapy, Brachy-therapy, Radiotherapy using Radio Isotopes.	

UNIT V – RADIOBIOLOGY AND RADIOLOGICAL PROTECTION	(9)
Radiation Sensitivity of Biological Materials, Evidence on Radiobiological Damage from Cell Survival Curve, Radiation Effects on Humans, Maximum Permissible Dose Equivalent Limits, Hazard from Ingested Radioactivity substances, ICRP Regulations, Quality Factor and Sievert, Principles of Radiological Protection, Personnel Dosimetry.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. Mary Alice S, Paula J Visconti, E Russell Ritenour, Kelli Haynes,"Radiation Protection In Medical Radiography", Elsevier Health Sciences, 2014.
2. Glasser O., "Medical Physics", Volume I, II, III, The Year Book Publishers Inc, Chicago, 1980.

REFERENCES:

1. Moselly H., "Non Ionizing Radiation", Adam-Hilgar, Bristol, 1988.
2. Khan,F.M, "Physics for Radiation Therapy", Williams & Wilkins, 2009.
3. Gopal B.Saha, "Physics and Radiation biology of Nuclear Medicine", 2006.

17BMM06 – RADIOLOGICAL IMAGING TECHNIQUES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To gain knowledge on quality assurance test for radiography, method of recording sectional images.	**1.1**	Students will be able to gain knowledge on quality assurance test for radiography, method of recording sectional images.	**a,b,e,g**
2.0	To learn the functioning of radio isotopic imaging equipment.	**2.1**	Students will be able to learn the functioning of radio isotopic imaging equipment.	**a,c,g**
3.0	To interpret the image acquisition, reconstruction and imaging outputs of MRI.	**3.1**	Students will be able to interpret the image acquisition, reconstruction and imaging outputs of MRI.	**a,b,g**
4.0	To understand the ultrasound imaging techniques.	**4.1**	Students will be able to understand the ultrasound imaging techniques.	**a,b,g**
5.0	To identify the IR medical imaging techniques for specific pathology.	**5.1**	Students will be able to analyze the various aspects of Thermography in pathology.	**a,b,d,g**

UNIT I – X-RAY AND CT IMAGING	**(9)**
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.	
UNIT II – PET AND SPECT IMAGING	**(9)**
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.	
UNIT III – MAGNETIC RESONANCE IMAGING	**(9)**
Principles of MRI Pulse Sequence – Image Acquisition and Reconstruction Techniques – MRI Instrumentation Magnetic Gradient System RF Coils – Receiver System Functional MRI – MRI Artifacts- Various Types of Pulse Sequences for Fast Acquisition of Imaging, NMR Spectroscopy - Application of MRI.	

UNIT IV – ULTRASOUND IMAGING	(9)
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 Color Flow Mapping – Applications of Diagnostic Ultra Sound.	
UNIT V – INFRA-RED IMAGING	**(9)**
Physics of Thermography – Imaging Systems – Pyroelectric Videocon Camera Clinical Thermography – Liquid Crystal Thermography.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. John Ball and Tony Price Chesney's, "Radiographic Imaging", Blackwell Science Limited, U.K., 2006.
2. Farr, "The Physics of Medical Imaging", Adem Hilger, Bristol & Philadelphia, 2007.
3. S Webb, "The Physics of Medical Imaging", Adam Highler, Bristol Published by CRC Press, first edition 1988.

REFERENCES:

1. M. Analoui, J.D. Bronzino, D.R.Peterson, "Medical Imaging: Principles and Practices", CRC Press, 2012.
2. S. Webb, "Physics of Medical Imaging", Taylor & Francis, 2010.
3. T. Farncombe, K. Iniewski, "Medical Imaging: Technology & Applications", CRC Press, 2013.
4. J.S. Benseler, "The Radiology Handbook: A Pocket Guide to Medical Imaging", Ohio University Press, 2006.
5. R.R.Carlton, A.M.Adler, "Principles of Radiographic Imaging: An Art and a Science", 5th Edition, Delmar Cengage Learning; 2012.
6. N.B.Smith, A. Webb, "Introduction to Medical Imaging Physics, Engineering and Clinical Applications", CRC Press, 2010.

17BMM07 – ICU AND OPERATION THEATRE EQUIPMENT				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To offer clear understanding of various intensive care equipment and their working.	**1.1**	Students will be able to offer clear understanding of various intensive care equipment and their working.	**a,b,d,e,g,l**
2.0	To suggest suitable critical care equipments and operational devices.	**2.1**	Students will be able to suggest suitable critical care equipments and operational devices.	**a,b,d,e,g,l**
3.0	To understand the necessity of different operation theatre equipment.	**3.1**	Students will be able to understand the necessity of different operation theatre equipment.	**a,b,d,e,g,i,l**
4.0	To acquire knowledge on centralized systems.	**4.1**	Students will be able to acquire knowledge on centralized systems.	**a,b,d,g**
5.0	To analyze the quality of equipment and ensure patient safety.	**5.1**	Students will be able to analyze the quality of equipment and ensure patient safety.	**a,b,d,f,g,h**

UNIT I – ICU EQUIPMENT	**(9)**
Suction Apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for Small and Larger Units. Automated Drug Delivery Systems, Infusion Pumps, Closed Loop Control Infusion System, Implantable Infusion System.	
UNIT II – CRITICAL CARE EQUIPMENT	**(9)**
Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine Controls and Measurements. Heart Lung Machine, Different Types of Oxygenators, Peristaltic Pumps, Incubators.	
UNIT III – OPERATION THEATRE EQUIPMENT	**(9)**
Surgical Diathermy, Instruments for Operation. Anesthesia Equipment, Humidification, Sterilization Aspects, Boyles Apparatus.	
UNIT IV – CENTRALISED SYSTEMS	**(9)**
Centralized Oxygen, Nitrogen, Air Supply & Suction. Centralized Air Conditioning, Operation Theatre Table & Lighting.	

UNIT V – PATIENT SAFETY	(9)
Patient Electrical Safety, Types of Hazards, Natural Protective Mechanisms against Electricity, Leakage Current, Inspection of Grounding and Patient Isolation, Hazards in Operation Rooms, ICCU and IMCUs, Opto couplers and Pulse Transformers.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Khandpur R. S, "Handbook of Biomedical Instrumentation", 2nd Edition, Tata Mc Graw Hill Pub. Co., Ltd. 2003.
2. John, G. Webster, "Medical Instrumentation, Application and Design", 2nd Edition, John Wiley & Sons, Inc., NewYork, 2008.

REFERENCES:

1. Joseph Dubovy, "Introduction to Biomedical", Mc Graw Hill Co, 1978.
2. Terry Bahil. A, "Biomedical and Clinical Engineering", Prentice Hall Inc., 1981.

17BMM08 – BIOMATERIALS AND ARTIFICIAL ORGANS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To study the characteristics and classification of biomaterials	**1.1**	The students will be able to understand the structure and mechanical properties of biomaterials	**a,b,c,d,e,f,g**
2.0	To learn about the metallic and Ceramic materials in tissue replacements	**2.1**	The students will be able to interpret various metallic and ceramic implant materials in medical field	**a,b,c,d,e,f,g, h,k,l**
3.0	To learn about the polymeric materials and composites in tissue replacements	**3.1**	The students will be able to implement various polymeric implant materials according to the need for treatment	**a,b,c,d,e,f,g, h,k,l**
4.0	To study the soft and hard tissue replacement in biomedical applications	**4.1**	The students will be able to analyze soft and hard tissue replacement implants in biomedical applications	**a,b,c,d,e,f,g, h,k,l**
5.0	To know the compatibility and functioning of artificial organs inside the living system	**5.1**	The students will be able to assess compatibility and functioning of artificial organs inside the living system	**a,b,c,d,e,f,g, h,k,l**

UNIT I – BIO-MATERIALS STRUCTURE AND BIO-COMPATIBILITY	**(9)**
Definition and Classification of Bio-materials, Mechanical Properties of Biomaterials, Structure Property Relationship of Biological and Biomaterials Viscoelasticity, Wound Healing Process, Body Response to Implants, Blood Compatibility, Carcinogenicity.	
UNIT II – IMPLANT MATERIALS I	**(9)**
Metallic Implant Materials: Stainless Steels, Cobased Alloys, Ti-Based Alloys, Dental Metals, Deterioration of Metallic Implant Materials. Ceramic Implant Materials: Structure–Property Relationship of Ceramics, Aluminum Oxides, Zirconia, Hydroxyapatite, Glass Ceramics, Carbons.	
UNIT III – IMPLANT MATERIALS II	**(9)**
Polymerization, Polyamides, Acryrilic Polymers, Rubbers, High Strength Thermoplastics, Deterioration of Polymers, Bio Polymers: Collagen and Elastin. Composites – Structure, Mechanics, Biocompatibility, Applications. Materials for Ophthalmology: Contact Lens, Intraocular Lens.	

UNIT IV – TISSUE REPLACEMENT IMPLANTS	(9)
Soft Tissue Replacements, Sutures, Surgical Tapes, Adhesive, Percutaneous and Skin Implants, Maxillofacial Augmentation, Vascular Grafts, Hard Tissue Replacement Implants, Internal Fracture Fixation Devices, Joint Replacements.	
UNIT V – ARTIFICIAL ORGANS	**(9)**
Blood Substitutes, Artificial Skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial Lung (Oxygenator), Artificial Kidney (Dialyser Membrane), Artificial Pancreas, Dental Implants.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Sujata V. Bhatt, “Biomaterials”, 7th Edition, Narosa Publishing House, 2005.
2. Michael Lysaght, Thomas J Webster, “Biomaterials for Artificial Organs”, Elsevier Science, 2018.

REFERENCES:

1. Park Joseph D.Bronzino, “Biomaterials-Principles and Applications”, CRC Press, 2003.
2. J. Park, “Biomaterials: An Introduction”, Springer Science & Business Media, 2012.
3. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design”, McGraw-Hill, 2003.

17ITX37 PROBLEM SOLVING USING JAVA				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcome
1.0	To understand the basics of Java Programming Language	**1.1**	The Students will be able to solve simple problems using Java.	**a,b,c,d,e, h,j,k,l**
2.0	To understand fundamentals of programming such as conditional and iterative execution	**2.1**	The students will be able to write programs using branching and looping statements	**a,b,c,d,e, h,i,j,k,l**
3.0	To understand the concepts of Java arrays and Strings.	**3.1**	The students will be able to Be able to develop confidently with Strings and implement arrays.	**a,b,c,d,e, h,i,j,k,l**
4.0	To understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods.	**4.1**	The students will be able to understand basic oops concepts and develop applications using inheritance and interfaces.	**a,b,c,d,e, h,i,j,k,l**
5.0	To understand threads and collection concepts	**5.1**	The students will be able to build applications using threads and collection framework.	**a,b,c,d,e, h,i,j,k,l**

UNIT I - INTRODUCTION TO JAVA	(9)
History of java-Features-Glimpse of java-Data types and Variables-Local variable-Instance variable-static variable-Keywords: this, super, final- Type conversion & casting- Importance of Scanner class-Getting started with Eclipse IDE and VSCode.	
UNIT II-OPERATORS AND DECISION MAKING STATEMENTS	(9)
Operators- Arithmetic Operator, Bitwise Operator, Conditional Operator, Unary Operator-Relational and Logical operators-Conditional statements: If else, If else if, Nested if -Looping Statements: For Loop, while Loop, do while loop-switch-break-continue- auto boxing and unboxing**.**	
UNIT III-ARRAYS AND STRINGS	(9)
Arrays: One Dimensional Array-Two Dimensional Array-Inbuilt functions in arrays. Strings-String array-Inbuilt functions in Strings-String Buffer class-String Builder class-String Tokenizer class	
UNIT IV-OBJECT-ORIENTED PROGRAMMING PARADIGM	(9)
Class-objects-Encapsulation-Inheritance and its types-Polymorphism: Static binding and dynamic binding-Methods –Constructors and its types-Abstract class-Interface.	
UNIT V- MULTITHREADING AND COLLECTIONS	(9)
Throwable classes-Exception types-Exception keywords-Collection classes: List, Set-Thread-Ways of thread creation-methods-thread priorities-Synchronization-multithreading-Lambda Expression.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOK:

1. Herbert Schildt, “Java:The Complete Reference”,McGraw Hill Education, Twelfth edition,2021.

REFERENCE:

1. Cay.S.Horstmann,GaryCornell, “Core Java-JAVA Fundamentals”, Prentice Hall,Eleventh edition, 2020.