Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
Deemed to be University
with Graded Autonomy Status
(An ISO 21001 : 2018 Certified Institution)
Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

FACULTY OF ENGINEERING AND TECHNOLOGY

OUTCOME BASED EDUCATION

Curriculum and Syllabus

B.TECH (BIOMEDICAL ENGINEERING)

2022

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION STATEMENT

We envision a department that renders services continuously to meet the requirements of the changing world in Biomedical Industry by educating the students for a global competition in line with Institution's Mission.

MISSION STATEMENT

M1	Enhance the quality of education by continuously updating curriculum and syllabi in correlation with the current trends
M2	Impart the students with latest technical and industry-oriented software skills required for problem solving, design, testing and implementation of solutions in modern Biomedical and other related industries
M3	Enrich entrepreneurial skills that contributes to social-economic growth by utilizing the advanced technologies in Biomedical field
M4	Kindle their creative skills and encourage them to be innovators and provide a path for research and higher education
M5	Enlighten their communication skills and team spirit such that they reach out efficiently to the public on management, deal various situations practicing ethics.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1	To educate students for successful careers in Biomedical Engineering. Emphasis is placed upon mastering the fundamentals of engineering and biology, the ability to solve engineering problems, and understanding the creative process of engineering design.
PEO2	To educate students for successful careers in Biomedical Engineering, emphasizing the fundamentals of engineering and biology related to basic medical sciences and human health
PEO3	To develop in students professional, ethical, and societal responsibility in Biomedical Engineering practices.
PEO4	To make the students to develop paramount of the health, safety, and welfare of the public, and conduct themselves in a professional and ethical manner at all times.
PEO5	To make the students to emerge as recognized experts in the field of biomedical engineering, and serve in positions of leadership in academics, government, medicine, or industry.

PROGRAMME OUTCOMES

PO1	Apply the knowledge of science and mathematics in designing, analyzing and using biomedical equipments for various hospital and clinical applications.
PO2	Design the modern biomedical machines, its driver circuits, power circuits, and control circuits for specific application.
PO3	Ability to identify, analyze and solve real-life engineering problems in the area of Biomedical and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs
PO4	Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Biomedical equipment in the hospital and clinical area.
PO5	Ability to develop and utilize modern tools for modeling, analyzing and solving various Engineering problems related to Biomedical Instrumentation
PO6	Willingness and ability to work in a team of engineers/ researchers with mutual understandings to take unsophisticated challenges, in the field of Biomedical Instrumentation, lead and motivate the group to inculcate multidisciplinary and collaborative approach.
PO7	Willingness and ability to take up administrative challenges including the management of various projects of interdisciplinary nature and carry out the same in an efficient manner giving due consideration to societal, environmental, economic and financial factors
PO8	Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents
PO9	Individual and team work: Function finer as an individual, and as a affiliate or baton in assorted teams, and in multidisciplinary settings.
PO10	Communication: Communicate finer on circuitous engineering activities with the engineering association and with association at large, such as, getting able to appreciate and address able letters and architecture documentation, accomplish able presentations, and accord and accept bright instructions
PO11	Project management and finance: Demonstrate ability and compassionate of the engineering and administration attempt and administer these to one‘s own work, as a affiliate and baton in a team, to administer projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the charge for, and accept the alertness and adeptness to appoint in absolute and life-long acquirements in the broadest ambience of abstruse change.

PROGRAMME SPECIFIC OBJECTIVES

PSO1	Graduates will be strong enough in mastering the fundamentals of engineering and biology, the ability to solve engineering problems, and understanding the creative process of engineering design.
PSO2	Graduates will administer software abilities in developing algorithms for analytic healthcare accompanying problems in assorted fields of medical sector.
PSO3	Graduates will familiarize on arising information and communication technologies (ICT) to innovate ideas and solutions for accepted civic and accurate issues thereby developing indigenous medical instruments that are on par with the absolute technology

PEO WITH MISSION STATEMENT

	M1	M2	M3	M4	M5
PEO1	3	2	2	3	3
PEO2	2	3	3	3	3
PEO3	3	1	1	3	3
PEO4	2	3	3	2	3
PEO5	2	2	3	3	2

PEO-PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	1	3	2	3	3	2	2	2	1	3	2
PEO2	2	3	3	3	3	3	2	3	3	2	1	2
PEO3	3	3	3	3	2	1	3	2	2	3	2	1
PEO4	3	3	3	1	3	2	2	3	2	3	3	2
PEO5	3	2	2	3	3	3	2	3	3	2	2	1

PEO WITH PSO

	PSO1	PSO2	PSO3
PEO1	3	3	2
PEO2	3	2	1
PEO3	3	2	3
PEO4	3	3	3
PEO5	3	3	3

Strength of correlation

3 - High, 2- Medium, 1-Low

Faculty of Engineering and Technology

Department of Biomedical Engineering

Regulation 2022 – Framework

Total Credits: 160 To 166

Credit for I & II Semester: 37 Credit

Credit for III TO VIII Semester: 129 Credits (Maximum)

Program Components

- Basic Science (Mathematics) include according to program
- Program Core theory - 15
- Program Core Laboratory - 09
- Program Elective - 05
- Open Elective - 02
- Open Lab - 01
- Foreign Language - 01
- Audit course - 01
- Universal Human values - 01
- Inter disciplinary theory - 05
- Inter disciplinary Lab - 02
- ETL - 10
- Technical Skills - 03
- Soft skill - 02
- Project /Mini project - 03

These subjects should not be changed in the curriculum and should be conducted in the given semester only. Other subjects can be fixed at the discretion of the Department.

I SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBEN22001	Technical English	Ty	2	0/0	0/0	2	HS
2	EBMA22002	Bio Mathematics	Ty	3	1/0	0/0	4	BS
3	EBPH22ET1	Engineering Physics	ETL	2	0/0	2/0	3	BS
4	EBCH22ET1	Engineering Chemistry	ETL	2	0/0	2/0	3	BS
5	EBME22ET1	Basic Mechanical & Civil Engineering	ETL	2	0/0	2/0	3	ES
6	EBCS22ET1	C Programming and MS Office Tools	ETL	1	0/0	2/0	2	ES
7	EBCC22I01	Orientation to Entrepreneurship & Project Lab	IE	0	0/0	2/0	1	HS
						Credits Sub Total	18	

II SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBMA22004	Bio Statistics	Ty	3	1/0	0/0	4	BS
2	EBPH22003	Bio Materials	Ty	3	0/0	0/0	3	BS
3	EBCH22001	Technical Chemistry	Ty	3	0/0	0/0	3	BS
4	EBME22001	Engineering Graphics	Ty	2	0/0	2/0	3	ES
5	EBBM22001	Electrical and Electronics Engineering	Ty	3	0/0	0/0	3	PC
6	EBCC22I02	Communicative English Lab	IE	1	0/0	1/0	1	HS
7	EBCS22ET2	Python Programming	ETL	1	0/0	2/0	2	ES
8	EBCC22I03	Environmental Science (Audit Course)	IE	1	0/0	1/0	0	HS
						Credits Sub Total	19	

TOTAL CREDITS: 37

Note:

Ty/Lb/ETL/IE: Theory/Lab/Embedded Theory and lab/Internal evaluation
L/T/S.Lr/P/R/C: Lecture/Tutorials/Supervised Learning/Practical/Research/Credit
HS: Humanities and Social Science, ES: Engg. Science BS: Basic Science, PC: Program Core, PE: Program Elective, OE: Open Elective, P: Project

III SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBBT22ID2	Human Anatomy and Physiology	Ty	3	0/0	0/0	3	ID
2	EBBM22002	Analog and Digital Electronics	Ty	3	0/0	0/0	3	PC
3	EBBM22003	Biomedical Instrumentation	Ty	3	0/0	0/0	3	PC
4	EBBT22ID3	Pathology and Microbiology	Ty	3	0/0	0/0	3	ID
5	EBBT22ID4	Biochemistry	Ty	3	0/0	0/0	3	ID
PRACTICALS*								
1	EBCC22ET1	Universal Human Values: Understanding harmony	ETL	1	0/0	2/0	2	HS
2	EBBT22IL2	Human Anatomy and Physiology Lab	Lb	0	0/0	3/0	1	ID
3	EBBM22L01	Analog and Digital Electronics Lab	Lb	0	0/0	3/0	1	PC
4	EBBM22L02	Biomedical Electronics and Instrumentation Lab	Lb	0	0/0	3/0	1	PC
5	EBBT22IL3	Biochemistry lab	Lb	0	0/0	3/0	1	ID
Credits Sub Total							21	

IV SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBMA22009	Laplace and Fourier Transforms	Ty	3	1/0	0/0	4	BS
2	EBBM22004	Biophysical Signals and Systems	Ty	3	1/0	0/0	4	PC
3	EBBM22005	Biosensors and Transducers	Ty	3	0/0	0/0	3	PC
4	EBBM22006	Microprocessor and Microcontroller for Biomedical	Ty	3	0/0	0/0	3	PC
5	EBCC22I04/ EBCC22I05	The Indian Constitution*/ The Indian Traditional Knowledge* (Audit Course)	IE	2	0/0	0/0	0	HS
PRACTICALS*								
1	EBBM22ET1	Bio Control System	ETL	2	0/0	2/0	3	PC
2	EBBM22L03	Biosensors and Transducers Lab	Lb	0	0/0	3/0	1	PC
3	EBBM22L04	Microprocessor and Microcontroller Lab	Lb	0	0/0	3/0	1	PC
4	EBBM22L05	Calibration lab	Lb	0	0/0	3/0	1	PC
5	EBBM22I01	Technical Skills I	IE	0	0/0	2/0	1	SC
6	EBCC22I06	Soft Skills I - Employability Skills	IE	0	0/0	2/0	1	SC
Credits Sub Total							22	

V SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBBM22007	Diagnostic and Therapeutic Equipments	Ty	3	0/0	0/0	3	PC
2	EBBM22008	Medical Robotics and Automation	Ty	3	1/0	0/0	4	PC
3	EBBM22009	Artificial Organs and Implants	Ty	3	0/0	0/0	3	PC
4	EBBM22EXX	Program Elective I	Ty	3	0/0	0/0	3	PE
5	EBXX22OEX	Open Elective I	Ty	3	0/0	0/0	3	OE
6	EBOL22I01	Online Course (NPTEL/SWAYAM/ any MOOC approved by AICTE/UGC)	IE	1	0/0	1/0	1	PC
PRACTICALS*								
1	EBBM22ET2	Embedded Systems	ETL	2	0/0	2/0	3	PC
2	EBBM22L06	Biophysical Signals and Systems Lab	Lb	0	0/0	3/0	1	PC
3	EBBM22L07	Diagnostic and Therapeutic Equipment Lab	Lb	0	0/0	3/0	1	PC
4	EBBM22I02	Technical Skills II	IE	0	0/0	2/0	1	SC
						Credits Sub Total	23	

VI SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBBM22010	Bio Signal Processing	Ty	3	1/0	0/0	4	PC
2	EBBM22011	Rehabilitation and Assistive Technology	Ty	3	0/0	0/0	3	PC
3	EBCS22ID5	Artificial Intelligence and Machine Learning	Ty	3	0/0	0/0	3	ID
4	EBBM22EXX	Program Elective II	Ty	3	0/0	0/0	3	PE
5	EBXX22OEX	Open Elective II	Ty	3	0/0	0/0	3	OE
PRACTICALS*								
1	EBBM22ET3	Communication Systems for Medical Application	ETL	2	0/0	2/0	3	PC
2	EBBM22L08	Bio Signal Processing Lab	Lb	0	0/0	3/0	1	PC
3	EBBM22I03	Technical Skills III	IE	0	0/0	2/0	1	SC
4	EBBM22I04	Mini Project/ Internship	IE	0	0/0	3/0	1	P
5	EBCC22I07	Soft Skills II - Qualitative and Quantitative Skills	IE	0	0/0	2/0	1	SC
						Credits Sub Total	23	

VII SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBBM22012	Medical Imaging Techniques	Ty	3	0/0	0/0	3	PC
2	EBBM22013	Telemedicine Technology	Ty	3	0/0	0/0	3	PC
3	EBBM22014	Medical Waste Management	Ty	3	0/0	0/0	3	PC
4	EBBM22015	Biomedical Optics	Ty	3	0/0	0/0	3	PC
5	EBBM22EXX	Program Elective III	Ty	3	0/0	0/0	3	PE
PRACTICALS*								
1	EBBM22ET4	Medical Instruments and System	ETL	2	0/0	2/0	3	PC
2	EBBM22L09	Biomedical Image Processing Lab	Lb	1	0/0	3/0	1	PC
3	EBXX22OLX	Open Lab	Lb	0	0/0	3/0	1	OE
4	EBBM22I05	Project Phase – 1	IE	0	0/0	3/3	2	P
5	EBFL22IXX	Foreign Language	IE	0	0/0	3/0	1	HS
						Credits Sub Total	23	

VIII SEMESTER								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBCC22ID4	Medical Innovation and Entrepreneurship	Ty	3	0/0	0/0	3	ID
2	EBBM22EXX	Program Elective IV	Ty	3	0/0	0/0	3	PC
3	EBBM22EXX	Program Elective V	Ty	3	0/0	0/0	3	PC
PRACTICALS*								
1	EBBM22L10	Project Phase – II	Lb	0	0/0	12/12	8	P
						Credits Sub Total	17	

CREDIT SUMMARY

Semester: 1 : 18 Credits
Semester: 2 : 19 Credits
Semester: 3 : 21 Credits
Semester: 4 : 22 Credits
Semester: 5 : 23 Credits
Semester: 6 : 23 Credits
Semester: 7 : 23 Credits
Semester: 8 : 17 Credits
TOTAL CREDITS : 166

PROGRAM ELECTIVE - I								
S.NO	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ SLr**	**P/ R**	**C**	**Category**
1	EBBM22E01	Biometric Systems	Ty	3	0/0	0/0	3	PE
2	EBBM22E02	Bio MEMS	Ty	3	0/0	0/0	3	PE
3	EBBM22E03	Neural Network and Fuzzy Logic Control	Ty	3	0/0	0/0	3	PE
4	EBBM22E04	Biofluid and Dynamics	Ty	3	0/0	0/0	3	PE

PROGRAM ELECTIVE – II								
S.NO	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ SLr**	**P/ R**	**C**	**Category**
1	EBBM22E05	Tissue Engineering	Ty	3	0/0	0/0	3	PE
2	EBBM22E06	Computer Networks	Ty	3	0/0	0/0	3	PE
3	EBBM22E07	Drug Delivery Systems	Ty	3	0/0	0/0	3	PE
4	EBBM22E08	Radiological Equipments	Ty	3	0/0	0/0	3	PE

PROGRAM ELECTIVE – III								
S.NO	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBBM22E09	Medical Informatics	Ty	3	0/0	0/0	3	PE
2	EBBM22E10	Principles of Robotics	Ty	3	0/0	0/0	3	PE
3	EBBM22E11	Genetic Engineering	Ty	3	0/0	0/0	3	PE
4	EBBM22E12	Medical Equipment Maintenance and Troubleshooting	Ty	3	0/0	0/0	3	PE

PROGRAM ELECTIVE – IV								
S.NO	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBBM22E13	Electrical Safety and Quality Assurance	Ty	3	0/0	0/0	3	PE
2	EBBM22E14	Hospital Management	Ty	3	0/0	0/0	3	PE
3	EBBM22E15	IoT for Biomedical Sector	Ty	3	0/0	0/0	3	PE
4	EBBM22E16	Laser and Ultrasonic Application in Medicine	Ty	3	0/0	0/0	3	PE

PROGRAM ELECTIVE -V								
S.NO	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ SLr**	**P/ R**	**C**	**Category**
1	EBBM22E17	Forensic Science in Healthcare	Ty	3	0/0	0/0	3	PE
2	EBBM22E18	VR and AR in Healthcare	Ty	3	0/0	0/0	3	PE
3	EBBM22E19	Wearable Systems	Ty	3	0/0	0/0	3	PE
4	EBBM22E20	Intellectual Property Rights and Biosafety	Ty	3	0/0	0/0	3	PE

LIST OF OPEN ELECTIVES(S) OFFERED BY EEE/BME DEPARTMENT TO OTHER DEPARTMENT STUDENTS

OPEN ELECTIVE								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBEE22OE1	Electrical Safety for Engineers	Ty	3	0/0	0/0	3	OE
2	EBEE22OE2	Energy Conservation Techniques	Ty	3	0/0	0/0	3	OE
3	EBEE22OE3	Electric Vehicle Technology	Ty	3	0/0	0/0	3	OE
4	EBEE22OE4	Biomedical Instrumentation	Ty	3	0/0	0/0	3	OE
5	EBEE22OE5	Industrial Instrumentation	Ty	3	0/0	0/0	3	OE
6	EBEE22OE6	Solar Energy Conversion System	Ty	3	0/0	0/0	3	OE
7	EBEE22OE7	Wind Energy Conversion System	Ty	3	0/0	0/0	3	OE
8	EBEE22OE8	Energy Storage Technology	Ty	3	0/0	0/0	3	OE
9	EBEE22OE8	Electrical Machines	Ty	3	0/0	0/0	3	OE

OPEN LAB								
S.NO.	**COURSE CODE**	**COURSE NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBEE22OL1	Transducer Lab	Lb	0	0/0	3/0	1	OE
2	EBEE22OL2	PLC and SCADA Lab	Lb	0	0/0	3/0	1	OE
3	EBEE22OL3	Electrical Maintenance Lab	Lb	0	0/0	3/0	1	OE
4	EBEE22OL4	Power Electronics Lab	Lb	0	0/0	3/0	1	OE
5	EBEE22OL5	Bio Medical Instrumentation Lab	Lb	0	0/0	3/0	1	OE
6	EBEE22OL6	Electrical Machines Lab	Lb	0	0/0	3/0	1	OE

OPEN ELECTIVE(S) OFFERED BY OTHER DEPARTMENT TO EEE/BME DEPARTMENT STUDENTS

COMPUTER SCIENCE AND ENGINEERING

S.NO	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	Category
1	EBCS22OE1	Cyber security & Forensics	Ty	3	0/0	0/0	3	OE
2	EBCS22OE2	Artificial Intelligence	Ty	3	0/0	0/0	3	OE
3	EBCS22OE3	Data Base Concepts	Ty	3	0/0	0/0	3	OE
4	EBCS22OE4	Software Engineering	Ty	3	0/0	0/0	3	OE

INFORMATION TECHNOLOGY

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBIT22OE1	Web Design	Ty	3	0/0	0/0	3	OE
2	EBIT22OE 2	Digital Marketing	TY	3	0/0	0/0	3	OE
3	EBIT22OE3	Cyber Security Essentials	Ty	3	0/0	0/0	3	OE
4	EBIT22OE4	Introduction to Multimedia	Ty	3	0/0	0/0	3	OE

ELECTRONICS AND COMMUNICATION ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBEC22OE1	Internet of Things and its Applications	Ty	3	0/0	0/0	3	OE
2	EBEC22OE2	Cellular Mobile communication	Ty	3	0/0	0/0	3	OE
3	EBEC22OE3	Satellite and its Applications	Ty	3	0/0	0/0	3	OE
4	EBEC22OE4	Fundamentals of Sensors	Ty	3	0/0	0/0	3	OE
5	EBEC22OE5	Microprocessor Based System	Ty	3	0/0	0/0	3	OE
6	EBEC22OE6	Industry 4.0 Concepts	Ty	3	0/0	0/0	3	OE

MECHANICAL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBME22OE1	Industrial Engineering	Ty	3	0/0	0/0	3	OE
2	EBME22OE2	Refrigeration and Air conditioning	Ty	3	0/0	0/0	3	OE
3	EBME22OE3	Automobile Engineering	Ty	3	0/0	0/0	3	OE
4	EBME22OE4	Industrial Robotics	Ty	3	0/0	0/0	3	OE
5	EBME22OE5	Sustainable Energy	Ty	3	0/0	0/0	3	OE
6	EBME22OE6	Composite Materials	Ty	3	0/0	0/0	3	OE
7	EBME22OE7	Industry 4.0	Ty	3	0/0	0/0	3	OE
8	EBME22OE8	Virtual and Augmented Reality	Ty	3	0/0	0/0	3	OE

CIVIL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBCE22OE1	Water Pollution and Its Management	Ty	3	0/0	0/0	3	OE
2	EBCE22OE2	Air Pollution Control	Ty	3	0/0	0/0	3	OE
3	EBCE22OE3	Green Building and Vastu Concepts	Ty	3	0/0	0/0	3	OE
4	EBCE22OE4	Climate Change and Sustainable Development	Ty	3	0/0	0/0	3	OE
5	EBCE22OE5	Intelligent Transportation Systems	Ty	3	0/0	0/0	3	OE
6	EBCE22OE6	Environment, Health and Safety in Industries	Ty	3	0/0	0/0	3	OE
7	EBCE22OE7	Industrial Pollution Prevention and Cleaner Production	Ty	3	0/0	0/0	3	OE
8	EBCE22OE8	Fundamentals of nanoscience	Ty	3	0/0	0/0	3	OE

BIOTECHNOLOGY

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBBT22OE1	Food and Nutrition	Ty	3	0/0	0/0	3	OE
2	EBBT22OE2	Human Physiology	Ty	3	0/0	0/0	3	OE
3	EBBT22OE3	Clinical Biochemistry	Ty	3	0/0	0/0	3	OE
4	EBBT22OE4	Bioprocess Principles	Ty	3	0/0	0/0	3	OE
5	EBBT22OE5	Biosensors and Biomedical Devices in Diagnostics	Ty	3	0/0	0/0	3	OE
6	EBBT22OE6	Basic Bioinformatics	Ty	3	0/0	0/0	3	OE

CHEMICAL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBCT22OE1	Fundamentals of Nanoscience	Ty	3	0/0	0/0	3	OE
2	EBCT22OE2	Electrochemical Engineering	Ty	3	0/0	0/0	3	OE
3	EBCT22OE3	Alternative Fuels And Energy	Ty	3	0/0	0/0	3	OE
4	EBCT22OE4	Petrochemical Unit Processes	Ty	3	0/0	0/0	3	OE
5	EBCT22OE5	Principles of Desalination	Ty	3	0/0	0/0	3	OE
6	EBCT22OE6	Piping Design Engineering	Ty	3	0/0	0/0	3	OE
7	EBCT22OE7	E- Waste Management	Ty	3	0/0	0/0	3	OE

Dr APJ Abdul Kalam Center for Research

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBMG22OE1	Technical Entrepreneurship	Ty	3	0/0	0/0	3	OE
2	EBMG220E2	Advanced Program in Entrepreneurship	Ty	3	0/0	0/0	3	OE

DEPARTMENT WISE OPEN ELECTIVES LAB LIST

COMPUTER SCIENCE AND ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBCS22OL1	Artificial Intelligence Lab	Lb	0	0/0	3/0	1	OE
2	EBCS22OL2	PHP/My SQL Programming Lab	Lb	0	0/0	3/0	1	OE
3	EBCS22OL3	Database Lab	Lb	0	0/0	3/0	1	OE

INFORMATION TECHNOLOGY

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBIT22OL1	Visual Programming Lab	Lb	0	0/0	3/0	1	OE
2	EBIT22OL2	Web Design Lab	Lb	0	0/0	3/0	1	OE
3	EBIT22OL3	Digital content creation Lab	Lb	0	0/0	3/0	1	OE
4	EBIT22OL4	Computer Network Lab	Lb	0	0/0	3/0	1	OE
5	EBIT22OL5	PHP/My SQL Programming Lab	Lb	0	0/0	3/0	1	OE

ELECTRONICS AND COMMUNICATION ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBEC22OL1	Sensors and IoT Lab	Lb	0	0/0	3/0	1	OE
2	EBEC22OL2	Robotics Control Lab	Lb	0	0/0	3/0	1	OE
3	EBEC22OL3	Basics of MATLAB	Lb	0	0/0	3/0	1	OE

MECHANICAL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBME22OL1	Internal Combustion Engines and Steam Lab	Lb	0	0/0	3/0	1	OE
2	EBME22OL2	Computer Aided Design and Simulation Lab	Lb	0	0/0	3/0	1	OE
3	EBME22OL3	Engineering Metrology Lab	Lb	0	0/0	3/0	1	OE
4	EBME22OL4	Automation Lab	Lb	0	0/0	3/0	1	OE
5	EBME22OL5	Virtual and Augmented Reality Lab	Lb	0	0/0	3/0	1	OE

CIVIL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBCE22OL1	Building Drawing Practice using Auto CADD	Lb	0	0/0	3/0	1	OE
2	EBCE22OL2	Geographical Information System And Mapping Lab	Lb	0	0/0	3/0	1	OE
3	EBCE22OL3	Environmental Engineering Laboratory	Lb	0	0/0	3/0	1	OE

BIOTECHNOLOGY

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBBT22OL1	Basic Biochemistry Lab	Lb	0	0/0	3/0	1	OE
2	EBBT22OL2	Basic Bioprocess Lab	Lb	0	0/0	3/0	1	OE
3	EBBT22OL3	Basic Microbiology Lab	Lb	0	0/0	3/0	1	OE
4	EBBT22OL4	Basic Bioinformatics Lab	Lb	0	0/0	3/0	1	OE

CHEMICAL ENGINEERING

S.NO.	COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	Category
1	EBCT22OL1	Chemical Separation Lab	Lb	0	0/0	3/0	1	OE
2	EBCT22OL2	Chemical Composition Analysis Lab	Lb	0	0/0	3/0	1	OE
3	EBCT22OL3	Alternate Fuel Lab	Lb	0	0/0	3/0	1	OE
4	EBCT22OL4	Food Testing Laboratory	Lb	0	0/0	3/0	1	OE

LIST OF FOREIGN LANGUAGES - 2022 Regulation

S.NO	COURSE CODE	COURSE NAME
1	EBFL22I01/HBFL22I01	FRENCH
2	EBFL22I02/ HBFL22I02	GERMAN
3	EBFL22I03/ HBFL22I03	JAPANESE
4	EBFL22I04/ HBFL22I04	ARABIC
5	EBFL22I05/ HBFL22I05	CHINESE
6	EBFL22I06/ HBFL22I06	RUSSIAN
7	EBFL22I07/ HBFL22I07	SPANISH

Table.1: Components of Curriculum and Credit distribution for E&T Programmes

Course Component	Description	No. of Courses	Credits	Total	Credit Weightage (%)	Contact hours
Basic Science	Theory	**5**	**18**	**24**	**14.45**	**270**
	ETL	**2**	**6**			**90**
Engineering Science	Theory	**1**	**3**	**10**	**6.02**	**45**
	ETL	**3**	**7**			**105**
Humanities and Social Science	Theory	**1**	**2**	**07**	**4.21**	**30**
	Lab	**5**	**3**			**165**
	ETL	**1**	**2**			**30**
Program Core	Theory	**15**	**48**	**69**	**41.56**	**720**
	Lab	**9**	**9**			**405**
	ETL	**4**	**12**			**240**
Program Electives		**5**	**15**	**15**	**9.03**	**225**
Open Elective	Theory	**2**	**6**	**07**	**4.21**	**90**
	Lab	**1**	**1**			**45**
Inter-disciplinary	Theory	**5**	**15**	**17**	**10.24**	**225**
	Lab	**2**	**02**			**90**
	ETL	**0**	**0**			**0**
Skill Component		**05**	**05**	**05**	**3.01**	**225**
Project /Internship		**1**	**1**	**11**	**6.62**	**45**
		2	**10**			**90**
Others if any Online Courses		**1**	**1**	**1**	**0.6**	**30**
	TOTAL	**70**	**166**	**166**	**100%**	**3165**

Note:

Basic Science: Mathematics, Physics and Chemistry.

Engineering Science: Engineering Graphics, Basics of Mechanical and Civil Engineering, Basics of Electrical and Electronics Engineering, C Programming and MS office tools, Python Programming

Humanities and Social sciences:

English, Foreign language, Environmental Studies, Management, Entrepreneurship, Indian Constitution and Indian Traditional Knowledge, Universal Human Values.

Skill Component:

Technical Skill, Soft Skill, internship.

Table 2: Revision/modification done in syllabus content:

S.No	Course Code	Course Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
1.	EBBM22005	Biomedical sensors & Transducers	PN Junction Diode -Non-Contact Type Temperature. Ion Exchange Membrane Electrodes- Oxygen Electrodes, CO2 Electrodes Enzyme Electrode - Construction – ISFET for Glucose, Urea Etc. Electrolytic Sensors - Optical Sensor - Fiber Optic Sensors. Microbial Sensor - Enzyme Immobilization of Chemical Analyses	Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards. Intelligent Sensors: Definition, parameters, features, operating principle, main building blocks and applications. Optical techniques, General principles of optical sensing, Fiber-optic basics, Fiber-optic sensor technologies and applications. Fundamentals of ultrasonic-based sensors, Ultrasonic-based sensing methods and applications.	25
2.	EBBM22004	Biophysical Signals and Systems	Sampling theorem, Reconstruction of a Signal from its samples, aliasing, Laplace transform: basics, properties, inverse; z-transform: definition, properties, Poles and Zeros, inverse z-transform; Region of convergence (ROC), Representation of systems by differential equations and transfer functions. Basic Feedback concept, Positive and Negative Feedback, Control system, Open loop Control System, Control system With Feed Back, Application of feed back in physiological systems and its importance.		20
3.	EBBM22007	Diagnostic and Therapeutic Equipments	Bioelectric signals (ECG, EMG, EEG, EOG & ERG) and their characteristics - Electrodes for ECG, EEG and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine – EMG machine – 10-20 electrodes placement system for EEG - EEG machine – Heart sound and characteristics, PCG	Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG. Recording and analysis of EMG waveforms, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement.	70

			Electro diagnosis – Electrotherapy – Electrodes - Stimulators for Nerve and Muscle - Stimulator for pain relief - Interferential current therapy - Spinal cord stimulator - Diaphragm pacing for artificial ventilation -Functional Electrical Stimulation.	Instruments for surgery - principle of surgical diathermy - surgical diathermy machine - safety aspects in Electro-Surgical diathermy Units. Physiotherapy and electrotherapy equipment - High frequency heat therapy - short wave Diathermy - Microwave diathermy - Ultrasonic therapy unit - Pain relief through Electrical Stimulation - Bladder Stimulators - Cerebellar Stimulators. Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameter. Principles of Cryogenic technique and its application, Endoscopy, Laparoscopy, Thermography Modern ventilators - High frequency ventilators. Humidifiers - Nebulizers and Aspirators –Spirometer	
4	EBBM22L06	Biophysical Signals and Systems Lab			100%
5	EBBT22ID2	Human Anatomy and Pathology			70%

Table3:

List of New courses/value added courses//life skills/Electives/interdisciplinary /courses focusing on employability/entrepreneurship/skill development.

Sl.No	New Courses	Value Added Courses	Life skill	Electives	Inter Disciplinary	Focus on employability/ entrepreneurship/ skill development.
1	Biomedical Instrumentation					Employability
2	Pathology and Microbiology				Yes	
3	Biochemistry				Yes	
4	Biochemistry lab				Yes	
5	Laplace and Fourier Transforms				Yes	
6	Microprocessor and Microcontroller for Biomedical Engineers					Skill Development
7	Bio Control System					Skill Development
8	Microprocessor and Microcontroller Lab					Skill Development
9	Calibration lab					Skill Development
10	Artificial organs and implants					Employability
11	Embedded Systems					Employability
12	Diagnostic and Therapeutic Equipment Lab					Employability
13	Artificial Intelligence and Machine Learning				Yes	
14	Communication Systems for Medical Application					Employability
15	Biosignal Processing Lab					Skill Development
16	Medical Imaging Techniques					Employability
17	Telemedicine Technology					Skill Development
18	Medical Waste Management					Skill Development
19	Medical Instruments and System					Employability
20	Biomedical Image Processing Lab					Employability

21	Medical Innovation and Entrepreneurship					Entrepreneurship
22	Biometric Systems			Yes		
23	Neural Network and Fuzzy Logic Control			Yes		
24	Biofluid and Dynamics			Yes		
25	Computer Networks			Yes		
26	Radiological Equipments			Yes		
27	Medical Informatics			Yes		
28	Principles of Robotics			Yes		
29	Medical Equipment Maintenance and Troubleshooting			Yes		
30	Electrical Safety and Quality Assurance			Yes		
31	Forensic Science in Healthcare			Yes		
32	VR and AR in Healthcare			Yes		
33	Wearable Systems			Yes		

Course Code EBEN22001	Course Name : TECHNICAL ENGLISH	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	Ty	2	0/0	0/0	2

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

To refresh and stimulate students' English learning through Content Integrated Language Learning to have an in-depth understanding of the components of English language and its use in communication that they are competent in inter-personal and academic communication for a successful career.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Refresh and stimulate their English learning through Content Integrated Language Learningming
CO2	Have an in-depth understanding of the components of English language and its use in communication.
CO3	Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication
CO4	Learn to negotiate meaning in inter-personal and academic communication for a successful career
CO5	Engage in organized academic and professional writing for life-long learning and research

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	3	1	1	2	3	3	1	3
CO2	-	1	-	2	3	2	1	1	3	3	-	3
CO3	1	1	1	1	2	1	-	2	3	3	1	3
CO4	1	2	1	1	3	-	1	-	2	2	1	2
CO5	1	2	1	-	2	1	-	1	3	3	1	3

COs/PSOs	PSO1	PSO2	PSO3		
CO1	-	1	-		
CO2	-	1	-		
CO3	-	1	-		
CO4	-	1	1		
CO5	-	1	1		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary
			✓							

Course Code EBEN22001	Course Name : TECHNICAL ENGLISH	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	Ty	2	0/0	0/0	2

Unit I Vocabulary Development: **6**

Affixes: prefixes and suffixes and word formation–synonyms and antonyms-nominal compounds, expanding using numbers and approximation - preposition, prepositional phrases, preposition + relative pronoun- adjective: degrees of comparison, formation of adjectives, irregular comparatives- Infinitive and Gerunds

Unit II Grammar **6**

Tenses- auxiliary and modal –voice: active, passive and impersonal passive - Questions:Wh-pattern, Yes/no questions, tag questions – adverbs and adverbial clauses- 'If' clause, 'cause and effect','purpose'- Concord: subject-verb agreement

Unit III Reading **6**

Comprehension: extracting relevant information from the text, by skimming and scanning and inferring, identifying lexical and contextual meaning for specific information, identifying the topic sentence and its role in each paragraph, comprehension exercises - Note - making - Précis writing-instructions, suggestions and recommendations.

Unit IV Writing **6**

Jumbled sentences- paragraph writing coherence devices- discourse markers.Essay writing- Letter writing, Informal and formal: seeking permission to undergo practical training, letter to an editor of a newspaper complaining about civic problems and suggesting suitable solutions

Unit V Visual Aids in Communication **6**

Interpretation of diagrams - tables, flow charts, pie charts and bar charts, and their use in Business reports

Total No. of Periods: 30

Text book

1. Panorama_: Content Integrated Language Learning for Engineers, M. ChandrasenaRajeswaran&R.Pushkala,, Vijay Nicole Imprints Pvt. Ltd., Chennai

References

1. Bhatnagar & Bhatnagar, Communicative English for Engineers and Professionals, Pearson
2. Wren and Martin: Grammar and Composition, Chand & Co, 2006
3. https://learnenglish.britishcouncil.org
4. www.better-english.com/grammar/preposition.

Course Code EBMA22002	Course Name : **BIO MATHEMATICS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	**Ty**	**3**	**1/0**	**0/0**	**4**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES :

The student should be made to:

- To understand the Basic concepts in Matrices
- To understand the concepts in in Differentiation
- To analyze the Basic concepts in Integration
- To be able to understand concepts in Interpolation
- To understand the Basic concepts in Numerical Differentiation and Integration

COURSE OUTCOMES (COs) :

CO1	Apply concepts in Matrices
CO2	Know the Evaluation of basics in differentiation
CO3	Know the basic concepts of integration and its application
CO4	Understand the concept of inetrpoling techniques
CO5	Explore the knowledge of Numerical Differentiation and Integration

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3		
CO1	1	2	2		
CO2	1	2	2		
CO3	1	2	2		
CO4	1	2	2		
CO5	1	2	2		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
	✓											

Course Code EBMA22002	Course Name : **BIO MATHEMATICS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	**Ty**	**3**	**1/0**	**0/0**	**4**

UNITI MATRICES 12

Elementary operations on Matrices – Inverse of a Matrix – Solving simultaneous equations (atmost three equations with three unknowns) using Cramer's rule.

UNIT II DIFFERENTIATION 12

Basic concepts of Differentiation – Elementary differentiation methods –Parametric functions – Implicit function–Maxima and Minima(simple problems).

UNIT III INTEGRATION 12

Basic concepts of Integration– Methods of Integration–Integration by substitution – Integration by parts –Definite Integrals – Properties of Definite Integrals –Problems on finding Area using single integrals (simple problems).

UNIT IV INTERPOLATION 12

Interpolation: Newton's forward,Newton's backward formulae –Newton's divided differences – Lagrange's polynomial(simple problems).

UNIT V NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical differentiation with interpolation polynomials(Newton's forward and backward only) – Numerical integration by Trapezoidal and Simpson's (both $1/3^{rd}$& $3/8^{th}$) rules(simple problems).

Total No. of Periods : 60

Reference Books:

1. Shanti Narayanan, Differential Calculus, S.Chand&Co.,New Delhi, (2005).
2. Shanti Narayanan, Integral Calculus, S.Chand&Co.,New Delhi, (2005).
3. Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).
4. John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).
5. Veerarajan T., Numerical Methods, Tata McGraw Hill Publishing Co., (2007).

Course Code EBPH22ET1	Course Name : **ENGINEERING PHYSICS**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Higher Sec. Physics	**ETL**	**2**	**0/0**	**2/0**	**3**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	2	1	-	1	2	-	1
CO2	3	3	2	2	2	2	1	-	2	2	1	1
CO3	3	3	3	2	2	2	1	1	1	2	1	2
CO4	3	3	2	2	1	2	2	1	2	2	1	2
CO5	3	3	2	1	1	2	1	2	1	2	1	1

COs/PSOs	PSO1	PSO2	PSO3		
CO1	2	-	-		
CO2	2	2	-		
CO3	3	1	-		
CO4	2	1	1		
CO5	2	1	-		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
	✓								

Course Code EBPH22ET1	Course Name : ENGINEERING PHYSICS	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Higher Sec. Physics	**ETL**	**2**	**0/0**	**2/0**	**3**

UNIT I PROPERTIES OF MATTER 12

Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire – Shafts – Solid & Hollow Shafts – Bending moment – Youngs Modulus Determination -I form of girders.

viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer – Lubrication

Lab Component – 1. Torsional Pendulum – Determination of Rigidity Modulus

2. Coefficient of Viscosity determination using Poiseuille's Method

UNIT II ACOUSTICS & ULTRASONICS 12

Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics. Ultrasonics -Production of ultrasonic waves - detection of ultrasonic waves+ - acoustic grating - application of ultrasonic waves.

Lab Component – 3. Ultrasonic Velocity Determination

UNIT III WAVE OPTICS 12

Huygen`s principle - interference of light – wave front splitting and amplitude – air wedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - diffraction grating

Lab Component – 4. Spectrometer – Grating

UNIT IV LASER 12

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Lab Component – 5. Determination of Wavelength of the given Laser source

UNIT V FIBER OPTIC COMMUNICATION 12

Total Internal Reflection – Propagation of Light in Optical Fibers – Numerical aperture and Acceptance Angle – Types of Optical Fibers (material, refractive index, mode) – Fiber Optical Communication system (Block diagram) – Attenuation–Transmitter, Receiver, Dispersion, Modulation/Demodulation Advantages of Fiber Optical Communication System – IMT, PMT, Wavelength Modulated & Polarization Modulated Sensors – Endoscope Applications.

Lab Component – 6. Determination of Numerical Aperture of Optical Fiber

Total No. of Periods: 60

TEXT BOOKS

1. Brijlal, M. N. Avadhanulu& N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012
2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017
3. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016

REFERENCE BOOKS

1. Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
2. N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988
3. N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
4. N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
5. R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995
6. Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1988
7. Dr. S. Muthukumaran, Dr.G.Balaji,S.Masilamani - PHYSICS LABORATORY I & II by Sri Krishna Hitech Publishing Company Pvt. Ltd.

Course Code EBCH22ET1	Course Name: **ENGINEERING CHEMISTRY**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Higher Sec. Chemistry	**ETL**	**2**	**0/0**	**2/0**	**3**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To deduce practical application of theoretical concepts
- To provide and insight into fundamental concepts of chemical thermodynamics
- To articulate the water treatment methods
- To impart the knowledge in electrical conductance and EMF
- To create awareness about the modern Nano composites along with concepts of polymers
- To introduce analytical tools for characterization techniques.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	**Apply relevant instrumentation techniques to solve complex problems**
CO2	**Recall the fundamentals and demonstrate by understanding the first principles of Engineering sciences.**
CO3	**Examine the appropriate techniques to interpret data to provide valid conclusion**
CO4	**Demonstrate the collaboration of science and Engineering to recognize the need for life long learning.**
CO5	**Analyse the impact of contextual knowledge to access the health and society issues.**

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	3	3	-	-	-	2	-	-	-
CO2	3	3	-	-	-	3	-	-	-	-	-	3
CO3	3	-	2	3	-	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	3	-	-	-	3
CO5	3	-	-	-	-	2	3	2	-	-	-	3

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	2	3
CO2	-	2	3
CO3	-	2	3
CO4	-	3	3
CO5	-	3	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
	✓								

Course Code EBCH22ET1	Course Name: **ENGINEERING CHEMISTRY**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Higher Sec. Chemistry	**ETL**	**2**	**0/0**	**2/0**	**3**

UNIT -I CHEMICAL THERMODYNAMICS 12

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G).

UNIT -II TECHNOLOGY OF WATER 12

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler Troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal conditioning,external conditioning – Demineralization methods. Desalination processes-RO and Electrodialysis.

Lab Component-1. Analyze the water quality parameters for the given water sample.

UNIT -III ANALYTICAL AND CHARACTERIZATION TECHNIQUES 12

Chromatographic techniques – column, thin layer and paper. Instrumentation-working with block diagram- UV-Visible Spectroscopy , IR Spectroscopy , Scanning electron microscope ,Transmission electron microscope.

Lab Component-2.Determination of Rf values of various components using thin layer chromatography.
3. Compute and interpret the structures of the given molecules using Chem Draw.

UNIT – IV ELECTROCHEMISTRY 12

Conductance – Types of conductance and its Measurement. Electrodes and electrode potential, Nernst equation – EMF measurement and its applications-Electrochemical series- Types of electrodes-Reference electrodes-Standard hydrogen electrode- Saturated calomel electrode-Determination of P^H using these electrode.

Lab Component 4. Studies on acid-base conductometric titration.
5. Determination of redox potentials using potentiometry

UNIT –V POLYMERS AND NANO COMPOSITES 12

Polymers-Introduction-Monomers – Functionality – Degree of polymerization-Tacticity. Classification- Plastics – Thermoplastics and thermosetting plastics, Compounding of plastics – Compression moulding, injection moulding and extrusion processes. Nano composites:particulates,clay and carbon nano tubes.Graphene nano composites and its applications.
Lab Component-6.Polymeric analysis using capillary viscometer

Total No. of Periods : 60

References

1. Jain &JainEngineering Chemistry 17th Edition, Dhanpat Rai Publishing Company

2. Vasant R. Gowariker,, N. V. Viswanathan, Jayadev Sreedhar, Polymer Science,New Age International, 1986

3. B.K. Sharma, Polymer Chemistry, Goel Publishing House

4. Y. R. Sharma ,Elementary Organic Spectroscopy, S.Chand& Company Ltd.

5. N.Krishnamurthy, K.Jeyasubramanian, P.Vallinayagam, Applied Chemistry, Tata McGraw-Hill Publishing Company Limited, 1999.

6.Chichester,polymer-clay-nano composites,Johnwiley(2000)

Course Code EBME22ET1	Course Name :**BASIC MECHANICAL & CIVIL ENGINEERING**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	**ETL**	**2**	**0/0**	**2/0**	**3**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To understand the fundamentals and applications of IC Engines, power plants, manufacturing processes and mechanics.
- To expose the students to the various construction materials and their applications.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Demonstrate the working principles of power plants, IC Engines and boilers..
CO2	Utilize the concept of metals forming, joining process and apply in suitable machining process
CO3	Understand the various machining process in machine tool
CO4	Utilize the concept of Building materials and construction able to perform concrete mix and masonry types
CO5	Demonstrate how Roads, Railways, dams, Bridges have been constructed

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	3	3	3	-	3
CO2	3	-	-	-	1	2	-	1	2	2	-	2
CO3	3	3	-	-	1	1	-	1	2	2	-	2
CO4	3	-	-	-	1	1	-		2	2	-	2
CO5	3	-	-	-	1	1	-	1	2	2	-	2

COs/PSOs	PSO1	PSO2	PSO3	
CO1	1	-	-	
CO2	1	-	-	
CO3	1	-	-	
CO4	1	-	-	
CO5	1	-	-	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
		✓							

Course Code EBME22ET1	Course Name :**BASIC MECHANICAL & CIVIL ENGINEERING**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	**ETL**	**2**	**0/0**	**2/0**	**3**

UNIT I THERMAL ENGINEERING 14

Classification of internal combustion engine – Working of two stroke, four stroke petrol and diesel engines. Classification of Boilers – Cochran boiler – Locomotive boilers – Power plant classification – Working of Thermal and Nuclear power plant- Working of Solar-Wind - Tidal and Geothermal power plants.

Lab component: Study of Boilers and IC engines

UNIT II MANUFACTURING PROCESS 14

Metal forming processes – Rolling, forging, drawing, extrusion and sheet metal operations-fundamentals only. Metal Joining processes – Welding - arc and gas welding, Soldering and Brazing. Casting process – Patterns -Moulding tools - Types of moulding - Preparation of green sand mould - Operation of Cupola furnace.

Lab component: Sheet metal works,

Fitting- Cutting (T, V, L and dovetail joints)

UNIT III MACHINING PROCESS 10

Basics of metal cutting operations – Working of lathe- parts-Operations performed. Drilling machine – Classification – Radial drilling machine - Twist drill nomenclature. Milling machine-types-different operations performed.

Lab component: Lathe operation: Step turning and Taper turning

Drilling operation- Making hole drilling

UNIT IV BUILDING MATERIALS AND CONSTRUCTION 12

Materials: Brick - Types of Bricks - Test on bricks - Cement – Types, Properties and uses of cement – Steel - Properties and its uses – Ply wood and Plastics.

Construction: Mortar – Ingredients – Uses – Plastering - Types of mortar - Preparation – Uses – Concrete – Types – Grades – Uses – Curing – Introduction to Building Components (foundation to roof) – Masonry – Types of masonry (Bricks & Stones)

Lab component: Carpentry: Joints (Tee halving, Cross Lap, Dovetail Joint)

Plumbing works- Pipe connections

UNIT V ROADS, RAILWAYS, BRIDGES & DAMS 10

Roads – Classification of roads – Components in roads – Railways -Components of permanent way and their function – Bridges – Components of bridges – Dams – Purpose of dams – Types of dams.

Total No. of Periods: 60

TEXT BOOKS

1. S. Bhaskar, S. Sellappan, H.N.Sreekanth,, (2002), "*Basic Engineering*" –Hi-Tech Publications
2. K. Venugopal, V. Prabhu Raja, (2013-14), "*Basic Mechanical Engineering*", Anuradha Publications.
3. K.V. Natarajan (2000), *Basic Civil Engineering*,Dhanalakshmi Publishers
4. S.C. Sharma(2002),*Basic Civil Engineering*,Dhanpat Raj Publications

REFERENCES

1. PR.SL. Somasundaram, (2002), "Basic Mechanical Engineering" –, Vikas Publications.
2. S.C. Rangawala(2002), Building Material and Construction, S. Chand Publisher

Course Code EBCS22ET1	Course Name: **C PROGRAMMING AND MS OFFICE TOOLS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: None	**ETL**	**1**	**0/0**	**2/0**	**2**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES :

The student should be made to:

- Learn a programming language.
- Learn problem solving techniques.
- Write programs in C and to solve the problems.
- Familiarize the students in preparation of documents and presentations with office automation tools.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Understand and trace the execution of programs written in C language.
CO2	Write the C code for a given algorithm.
CO3	Apply Arrays and Functions concepts to write Programs
CO4	Apply Structures and pointers concepts for writing Programs
CO5	To perform documentation , accounting operations and presentation skills

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	1	1	1	1	2	2
CO2	2	2	2	2	1	1	1	1	1	1	2	2
CO3	2	2	3	2	1	1	1	1	1	1	3	2
CO4	2	2	3	3	1	1	1	1	1	1	3	2
CO5	1	1	1	1	1	1	-	-	2	3	2	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	1
CO4	2	1	1
CO5	2	1	1

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code EBCS22ET1	Course Name: **C PROGRAMMING AND MS OFFICE TOOLS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: None	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I Introduction **3**

Basic Structure of C programme- Constants, Variables and data types, Keywords, Identifiers- Operators and expressions- executing a C Program

UNIT II Decision making statements and looping statements **3**

Decision making with if statement, Simple if statement, else-if statement, Nesting if-else statement, The else if ladder,The switch statement, The goto statement, The while statement,, The do while statement, The for statement, jumps in loops

UNIT III Arrays and Functions **3**

Introduction to Arrays- One dimensional arrays, Two dimensional array, and Multidimensional array- Introduction to Functions- calling a function, category of functions- arguments with return values, argument with no return values- parameter passing Mechanism: Call by Value and Call by Reference. Recursion.

UNIT IV Structures& Pointers **3**

Structures definition, giving values to members, Structure initialization, comparison of structure variables, Structure within structures,Understanding pointers, accessing the address of the variable, declaring and initializing pointer, accessing a variable through its pointer and arrays

UNIT V Ms-Office **3**

Introduction to MS-Word- Menus- Introduction to MS-Excel: features of MS- Excel, spread sheet/worksheet, parts of MS-excel window, functions in excel sheet, chart, Introduction to MS-Power point

Total No. of Periods: 15

TEXT BOOKS:

1. E.Balaguruswamy, Programming in ANSI C
2. Padma Reddy ,Computer Concepts & 'C' Programming
3. ShobhaHangirke,Computer Application For Business

List of Experiments : **30 Periods**

C PROGRAMMING

1. Find the factorial of a given positive number using function.
2. Calculate X raised to y using function.
3. Find GCD and LCM of two given integer numbers using function.
4. Find the sum of N natural numbers using function.
5. Book information using Structure.
6. Student information using Structure.
7. Print the address of a variable and its value using Pointer
8. Find area and perimeter of a circle
9. Check whether the given number is palindrome or not

10. Check whether the given number is prime or not
11. Calculate sum of the digits of the given number
12. Display Fibonacci series up to N terms
13. Check whether a given character is alphabetic, numeric or special character
14. Count vowels and consonants in a given string
15. Find product of two matrices

MS-OFFICE

1. Preparing a news letter:
2. To prepare a newsletter with borders, two columns text, header and footer and inserting a graphic image and page layout.
3. Creating and editing the table
4. Printing envelopes and mail merge.
5. Using formulas and functions: To prepare a Worksheet showing the monthly sales of a company in different branch offices
6. Prepare a Statement for displaying Result of 10 students in 5 subjects

Course Code EBCC22I01	Course Name :**ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	**IE**	**0**	**0/0**	**2/0**	**1**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self-analysis to build an entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
CO5	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	3	2	2	2	-	2	2	2	1
CO2	3	2	-	3	2	3	2	3	3	3	2	2
CO3	-	2	2	2	-	3	-	3	3	3	-	-
CO4	-	3	2	2	2	2	-	3	2	2	3	-
CO5	-	2	2	3	2	2	3	3	2	2	3	1

COs/PSOs	PSO1	PSO2	PSO3		
CO1	1	-	-		
CO2	-	-	-		
CO3	2	1	1		
CO4	2	2	2		
CO5	1	1	1		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
								✓	

Course Code EBCC22I01	Course Name :**ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	**IE**	**0**	**0/0**	**2/0**	**1**

UNIT I CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR 3

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes.

UNITII ENTREPRENEURIAL STYLE 3

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

UNIT III DESIGN THINKING 3

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

UNIT IV RISK MANAGEMENT 3

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do?

UNIT V PROJECT 3

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

IDEA GENERATION, EVALUATION & PROJECT PRESENTATION 15

Total No. of Periods: 30

Reference Books& Website

1. Encyclopedia of Small Business (2011) – (e book)
2. Oxford Handbook of Entrepreneurship (2014)–(e book)
3. lms.learnwise.org

Course Code EBMA22004	Course Name :**BIO-STATISTICS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES :

The student should be made to:

- Understand the basic concepts in Statistics
- Understand the concepts in Correlation
- Understand the basic concepts in Probability theory
- Understand concepts in Testing of Hypothesis
- Analyze the concept in Design of Experiments

COURSE OUTCOMES (COs) :

CO1	Find the measures of central tendency and measures of dispersion
CO2	Evaluate the measures of skewness , kurtosis ,correlation and regression
CO3	Apply knowledge and concepts in finding the probability of a random variable and use addition and multiplication laws of probability
CO4	Test and give conclusion in testing of hypothesis
CO5	Analyze and interpret results through one and two way ANOVA

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3	
CO1	1	2	2	
CO2	1	2	2	
CO3	1	2	2	
CO4	1	2	2	
CO5	1	2	2	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											

Course Code EBMA22004	Course Name :**BIO-STATISTICS**	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

UNIT I BASICS OF STATISTICS 12

Variables – Uni-variate Data – Frequency Distribution – Measures of Central Tendency – Mean – Median –Mode – Quartiles – Measures of Dispersion – The Range – Quartile Deviation –Standard Deviation.

UNIT II CORRELATION 12

Measures of Skewness & Kurtosis – Bi-variate data – Correlation & Regression.

UNIT III PROBABILITY AND RANDOM VARIABLE 12

Definition of Random Experiment - Sample Space – Events: Mutually exclusive events - Exhaustive events - Dependent events and Independent events - Mathematical andStatistical definition of probability - Theorems of addition and multiplication laws ofProbability(Without proof) - Conditional probability (Simple problems).

UNIT IV SAMPLING 12

Tests of Significance – Large Sample Tests – Mean – Proportions – Small Sample Tests – t, F & Chi-square Tests – Independence of Attributes – Goodness of Fit.

UNIT V DESIGN OF EXPERIMENTS 12

Analysis of Variance: One Way & Two-Way Classification – Design of Experiments – Randomized Block Design –Completely Randomized Block Design –Latin Square Design.

Total No. of Periods: 60

Reference Books:

1) Gupta S.P, Statistical Methods,S.Chand& Co., New Delhi (2003).
2) Gupta S.C, KapoorV.K, Fundamentals of Mathematical Statistics,S.Chand& Co, New Delhi (2003).
3) Veerarajan T., Probability, Statistics and, Random Processes, Tata McGraw Hill Publishing Co., (2008).
4) Singaravelu, Probability and Random Processes, Meenakshi Agency, (2017).
5) Richard Johnson A., Miller & Freund's Probability and statistics for Engineers (9th ed), Prentice Hall of India, (2016).

Course Code EBPH22003	Course Name :**BIO MATERIALS**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg.Physics	Ty	3	0/0	0/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- Apply the science of materials to Engineering & Technology

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
CO2	Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
CO3	Identify significant gap required to overcome challenges and further development in polymeric materials
CO4	Create combinations of materials that could be used as a tissue replacement implant.
CO5	Understand the testing standards applied for biomaterials.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	-	-	2	-	1
CO2	3	3	1	2	2	1	1	-	1	2	-	1
CO3	3	3	3	3	2	2	2	1	-	2	1	1
CO4	3	3	3	3	2	2	1	1	3	2	1	1
CO5	3	2	2	2	2	1	1	1	2	2	1	1

COs/PSOs	PSO1	PSO2	PSO3	
CO1	3	2	2	
CO2	3	2	2	
CO3	3	2	2	
CO4	3	1	2	
CO5	3	1	2	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
	✓								

Course Code EBPH22003	Course Name :**BIO MATERIALS**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg.Physics	Ty	3	0/0	0/0	3

Unit I Introduction to Bio Materials 9

Introduction to biomaterials and requirements for biomaterial. Classification of biomaterials: metallic, ceramic, synthetic and natural polymers. Surface, Physical, Mechanical & bulk Properties of biomaterials: Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials.

Unit II Types of Bio Materials 9

Metallic and Ceramic Materials - Metallic implants – Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants,– common types Polymeric implant materials - Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications. Composite implant materials:

Unit III Surface Characterization 9

Surface properties and adhesion, contact angle measurement, scanning electron microscopy (SEM), transmission electron microcopy (TEM), scanning tunneling microscopy and atomic force microscopy (AFM).Secondary ion mass spectrometry and confocal laser scanning microscopy.

Unit IV 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.

Unit V Biomaterials Applications 9

Materials for bone and joint replacement – stainless steel, titanium based materials and porous metals. Ceramics: alumina, zirconia, calcium phosphate and bioactive glass, bone cement. Polymers: PMMA and polyethylene, rubber and fluorocarbon polymers. Materials for oral and maxillofacial surgery, ophthalmology and intelligent textiles for medical applications. (examples for each).

Total No. of Periods: 45

TEXT BOOKS & REFERENCE BOOKS

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.

Course Code EBCH22001	Course Name :**TECHNICAL CHEMISTRY**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg. Chemistry	Ty	3	0/0	0/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To identify the application of semiconductors in optics and solar cells.
- To analyze the radical improvement in electrical energy storage devices.
- To understand the degradation of electrical fittings and metallic joints.
- To solve chemical problems by simulation.
- To differentiate the various engineering materials by understanding its properties**.**

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Paraphrase the engineering knowledge by identifying proper chemical science technique.
CO2	Interpret appropriate solution for complex problems by using modern engineering and IT tools.
CO3	Retrieve and show the design solutions for safety and sustainable development.
CO4	Integrate the electrical and electronic concepts with professional ethics.
CO5	Articulate the technological changes recognizing the need for lifelong learning.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	3	-	-	-	-	-	-	-
CO2	3	-	3	3	3	-	-	-	-	-	-	-
CO3	3	-	3	3		-	3	2	-	-	-	-
CO4	3	-	-	-	-	-	-	3	-	-	-	3
CO5	3	-	3	-	-	-	3	-	-	-	-	2

COs/PSOs	PSO1	PSO2	PSO3	
CO1	3	3	3	
CO2	3	3	3	
CO3	3	3	3	
CO4	3	3	3	
CO5	3	3	3	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
	✓								

Course Code EBCH22001	Course Name :**TECHNICAL CHEMISTRY**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg. Chemistry	Ty	3	0/0	0/0	3

UNIT – 1 CHEMISTRY OF SEMICONDUCTORS 9

Semiconductors – Introduction – holes and electrons-Band theory-properties of semi conductors-Types of semiconductors-Intrinsic-Extrensic semiconductors -Mobility of electrons and Holes - Fermi level in Semiconductors- Industrial application of Semiconductors-Semiconductors in Optics - LEDs, OLEDs, Semiconductors in solar cells- Types - First generation solar cells - Single crystalline and poly crystalline solar cells -Czochralski Process of single crystalline silicon synthesis

UNIT -2 ELECTROCHEMICAL CELLS AND BATTERY TECHNOLOGY 9

Electrochemical cells: Galvanic cell (Daniel cell);Batteries: Classification of batteries, primary batteries (dry cells) and secondary batteries -nickel-cadmium ,lead-acid battery, Solid state batteries – Lithium battery, Lithium Sulphur battery, Fuel cells.

UNIT -3 DEVICECORROSION 9

Introduction – chemistry of IC and PCB- causes of corrosion on IC, PC-miniaturization, complex material utilization, production and service factors –environmental contamination (airborne contaminants) - Forms of corrosion – anodic, cathodic corrosion- Electrical Contact and metallic joints degradation- fretting corrosion - corrosion costs – corrosion protection of computer hardware.

UNIT-4 COMPUTATIONAL CHEMISTRY 9

Introduction, Software tools available for chemistry and its applications, Chem Draw- Designing a Chemical Structure- Shortcuts and Hotkeys on designing a chemical structure, Biopolymer Drawing, Advanced drawing Techniques. Structure Analysis, Creating 3D Models, Estimating and displaying Proton and carbon-13 NMR chemical shifts, Creating TLC Plates to find Rf values, Chem Draw/Excel functions.

UNIT -5 MODERN ENGINEERING MATERIALS FOR ELECTRONIC DEVICES 9

Alloys and Need for Alloys - Modern Electronic grade alloys-Applications in electrical components, transducers, electromagnetic shielding of computers, telecommunications equipment and rocket motor casings. Thin films- Preparation by the Sol-Gel Method-Application of thin films.

Total No. of Periods : 45

References

1. Oleg Roussak & H. D. Gesser, Applied Chemistry: A Textbook for Engineers and Technologists, Springer.
2. Samuel Glasstone, An Introduction of Electrochemistry, Franklin Classics Trade Press.
3. Kharton V.V, Solid state electrochemistry II: Electrodes, interfaces and ceramic membranes, Wiley
4. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Company.
5. Chemdraw 16.0 User Guide ,Perkin Elmer Informatics Inc.
6. Rolf E. Hummel, Electronic Properties of Materials, Springer

Course Code EBME22001	Course Name : **ENGINEERING GRAPHICS**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/0	2/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To acquire knowledge in geometrical drawing.
- To expose the students in computer aided drafting**.**

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids. And
CO5	Draw the sectional view of simple building drawing.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**3**	**3**	**-**	**3**
CO2	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**3**	**3**	**-**	**3**
CO3	**3**	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**2**	**2**	**-**	**2**
CO4	**3**	**3**	**2**	**2**	**-**	**3**	**-**	**2**	**3**	**3**	**-**	**3**
CO5	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**2**	**3**	**3**	**-**	**3**

COs/PSOs	PSO1	PSO2	PSO3	
CO1	1	-	-	
CO2	1	-	-	
CO3	1	-	-	
CO4	1	-	-	
CO5	1	-	-	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
		✓							

Course Code EBME22001	Course Name : **ENGINEERING GRAPHICS**	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/0	2/0	3

CONCEPTS AND CONVENTIONS (Not for examination) **5**

Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cycloids.

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

UNIT II PROJECTION OF SOLIDS **10**

Projection of simple solids like prism, pyramid, cylinder and cone in simple position
Sectioning of above solids in simple vertical position by cutting plane inclined to any one of the reference plane and perpendicular to the other.

UNIT III DEVELOPMMENT OF SURFACES **9**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders, and cones.

UNIT IVISOMETRIC PROJECTION **9**

Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

UNIT V ORTHOGRAPHICS PROJECTIONS **8**

Orthographic projection of simple machine parts – missing views

BUILDING DRAWING **7**

Building components – front, Top and sectional view of a security shed.
(Basic Auto CAD commands to be taught- not for Examinations)
Note: First angle projection to be followed.

Total No. of Periods: 60

TEXT BOOKS

1. Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House
2. Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.
3. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Course Code: EBBM22001	Course Name: ELECTRICAL & ELECTRONICS ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To understand the laws and theorems of electrical circuit.
- To gain knowledge on Electrical Machines and Measuring Instruments.
- To learn the working principle and characteristics of electron devices.
- To impart knowledge on rectifiers, filters and regulators
- To acquire knowledge on amplifiers and oscillators.

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Compute the electric circuit parameters for simple problems
CO2	Elaborate the concepts of Electrical Machines and Measurement Instruments.
CO3	Analyze the working principle and characteristics of electron devices
CO4	Gain knowledge on rectifiers, filters and regulators
CO5	Gain knowledge about the phenomenon of amplifiers and oscillators

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	-	-	-	-	--	-	-	1
CO2	3	2	-	2	-	-	-	-	-	-	-	1
CO3	3	2	-	2	-	-	-	-	--	-	-	1
CO4	3	2	-	2	-	-	-	-	--	-	-	1
CO5	3	2	-	2	-	-	-	-	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22001	Course Name: ELECTRICAL & ELECTRONICS ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNITI ELECTRIC CIRCUITS 9

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ) , Delta (Δ) – Wye (Y) Transformation – Theorem : Thevenin, Norton and Superposition Theorem.

UNIT II MACHINES & MEASURING INSTRUMENTS 9

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of Transformer –Operating principles and Types of measuring instruments – Moving coil, Moving iron – Principle of Energy meter

UNIT III ELECTRON DEVICES 9

Semiconductor Materials: Silicon and Germanium – PN Junction Diode, Zener Diode – Characteristics and Applications. Bipolar Junction Transistor - JFET, MOSFET, SCR –Characteristics and Applications – Operating principle

UNIT IV RECTIFIERS- FILTERS AND REGULATORS 9

Half wave rectifier- ripple factor- full wave rectifier- Harmonic components in a rectifier circuit Inductor filter- Capacitor filter- Simple circuit of a regulator using zener diode - Series and Shunt voltage regulators-Study of clippers- clampers – voltage multipliers

UNIT V AMPLIFIERS AND OSCILLATORS 9

Small signal low frequency transistor amplifier circuits: h-parameter representation of a transistor- Analysis of single stage transistor amplifier using h-parameters: voltage gain - current gain - Input impedance and Output impedance. Comparison of transistor configurations – Oscillators – Condition for sustained oscillation – Types of Oscillators.

Total No of Periods: 45

TEXT BOOKS:

1. D P Kothari, I J Nagrath, 2017, Basic Electrical Engineering, Second Edition, Tata McGraw-Hill Publisher, 2021.
2. A.K. Sawhney, 2015 A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & CO publisher
3. Millman and Halkias 2015, Electronic Devices and Circuits, Tata McGraw Hill
4. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, ―Electronic Devices and Circuits, Fourth Edition, Tata McGraw- Hill, 2017.

REFERENCE BOOKS:

1. R. Muthusubramanian, S. Salivahanan, K A Muraleedharan, Basic Electrical, Electronics and Computer Engineering, Second Edition, Tata McGraw-Hill Publisher
2. R.L. Boylestad and Louis Nashelsky,"Electronic Devices and Circuits", Pearson/Prentice Hall, 11th Edition, 2017.
3. P. Ramesh Babu, "Electronic Devices and Circuits",Scitech Publications Pvt- Ltd., 2013

Course Code EBCC22I02	Course Name : COMMUNICATIVE ENGLISH LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	IE	1	0/0	1/0	1

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To engage students in meaningful oral English communication and organized academic and professional reading and writing for a successful career.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Engage in meaningful oral communication in English with writing as a scaffolding activity.
CO2	Have an in-depth understanding of the components of English language and its use in oral communication.
CO3	Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication
CO4	Learn to negotiate meaning in inter-personal and academic communication for a successful career.
CO5	Engage in organized academic and professional writing for life-long learning and research

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	3	2	1	1	3	3	-	3
CO2	2	1	1	1	3	3	1	2	3	3	1	2
CO3	1	1	1	1	2	1	-	2	3	3	1	3
CO4	1	-	-	2	3	1	2	1	2	2	-	3
CO5	-	1	1	2	3	1	1	-	3	1	1	2

COs/PSOs	PSO1	PSO2	PSO3	
CO1	1	-	1	
CO2	2	1	1	
CO3	1	1	1	
CO4	-	-	2	
CO5	-	1	2	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
			✓						

Course Code EBCC22I02	Course Name : **COMMUNICATIVE ENGLISH LAB**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Pass in Plus 2 English	**IE**	**1**	**0/0**	**1/0**	**1**

Unit I **Listening** **6**

Authentic audios and videos

Prescribed Book: English Pronunciation in use – Mark Hancock,

Unit II **Speaking** **6**

Individual- Solo: Self introduction, Describing, anchoring, welcome address, vote of thanks,

Pair & Group: Role play- formal -informal, narrating stories, film review, analysing newspaper headings and reports, interpreting Advertisement pamphlets

Group discussion, mock interviews, formal presentation, power point presentation

Prescribed Book: J. C. Richards with J. Hull &S.Proctor, Interchange, Cambridge University Press, 2015.

Unit III **Reading** **6**

Extensive, focused reading,

Strategies for effective reading - Reading comprehensions – Note making- summarising-paraphrasing, Review

Suggested reading: Short stories, news paper reports, film reviews

Unit IV **Writing** **6**

Extensive writing practices – note taking, Cognitive and metacognitive strategies to inculcate a sense of organising ideas into coherent sentences and paragraphs, Formal letters, Business letters. Resume with covering letter

Unit V **Non verbal communication/ charts, diagrams and table** **6**

Interpretation of charts Flow chart, pie chart, bar diagram, table, tree diagram, etc.,

Total No. of Periods :30

Prescribed Text:

1. J. C. Richards with J. Hull &S.Proctor, Interchange, Level 2, Cambridge University Press, 2021.
2. M. ChandrasenaRajeswaran&R.Pushkala, English - Communication Lab Work book

Reference

1. Hancock, Mark, English Pronunciation in Use; Cambridge Univ. Press, 2013
2. Dutt, K, Rajeevan, G & Prakash, CLN 2008, *A Course on Communication Skills*, 1st edn, Cambridge University Press, Chennai

Course Code EBCS22ET2	Course Name: PYTHON PROGRAMMING	T y/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming and MS Office Tools	ETL	1	0/0	2/0	2

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE : The student should be made to:

- Develop a basic understanding of *programming* and the *Python programming* language
- Write programs in Python to solve real world problems
- See the value of *programming* in a variety of different disciplines, especially as it relates in engineering.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Remember the syntax and semantics of python programming language
CO2	Understand how functional and operations are to be utilized
CO3	Applythe fundamental programming constructs like variables, conditional logic, looping, and functions to build basic programs
CO4	design object-oriented programs with Python classes
CO5	Apply the knowledge to solve various real world problems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	1	1	1	-	1	1
CO2	3	2	2	2	2	1	1	1	1	-	1	1
CO3	3	2	2	2	2	1	1	1	1	-	1	1
CO4	3	3	3	2	2	1	2	-	2	-	2	2
CO5	3	3	3	3	2	1	2	-	2	-	2	2

COs / PSOs	PSO1	PSO2	PSO3		
CO1	2	2	2		
CO2	2	2	2		
CO3	2	2	2		
CO4	2	2	2		
CO5	2	2	2		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✔								

Course Code EBCS22ET2	Course Name: PYTHON PROGRAMMING	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming and MS Office Tools	ETL	1	0/0	2/0	2

UNIT I INTRODUCTION 9

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT II TYPES, OPERATORS AND EXPRESSIONS 9

Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass.

UNIT III FUNCTIONS 9

Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V OBJECT ORIENTED PROGRAMMING OOP IN PYTHON 9

Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

List of Experiment : Python Programming

1. Develop a python program to find the area and circumference of a circle.
2. Develop a python program to check if the number is positive or negative or zero using nested if else statement.
3. Develop a python program to find the GCD (Greatest Common Divisor) of two numbers.
4. Develop a Python program using function to compute the factorial of a given number.
5. Develop a Python program to find the sum of square of individual digits of a number using function.
6. Develop a Python program to find the largest digit from a number using function.
7. Develop a Python program to display only the positive elements of the list.
8. Develop a Python program to accept any number and print it in words.
9. Develop a Python program to subtract two matrices.
10. Develop a Python program to perform matrix multiplication.

Total No. of Periods: 45

TEXT BOOKS:

1. Python Programming: A Modern Approach, VamsiKurama, Pearson.
2. Think Python:How to Think Like a Computer Scientist'', 2nd editionUpdated for Python 3, Shroff/O'Reilly Publishers,Allen B. Downey
3. Learning Python, Mark Lutz, Orielly.

REFERENCE BOOKS:

1. Core Python Programming, W.Chun, Pearson.
2. Introduction to Python, Kenneth A. Lambert, Cengage.

Course Code: EBCC22I03	Course Name: ENVIRONMENTAL SCIENCE (AUDIT COURSE)	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	1	0/0	1/0	0

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

COURSE OUTCOMES (COs): (3 – 5) Students completing the course were able to

CO1	Know about Environment and Ecosystem & Biodiversity
CO2	Comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources
CO3	Discover water conservation and watershed management
CO4	Identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	Explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	3	2	-	-	-	1
CO2	-	-	-	-	-	2	3	-	-	2	-	1
CO3	-	-	-	-	-	2	3	2	-	-	-	1
CO4	-	-	-	-	-	2	3	2	-	2	-	1
CO5	-	-	-	-	-	2	3	-	-	2	-	1

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
			✓						

Course Code EBCC22I03	Course Name: ENVIRONMENTAL SCIENCE (AUDIT COURSE)	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	1	0/0	1/0	0

UNIT I ENVIRONMENT AND ECOSYSTEM 3

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem- producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

UNIT II ENVIRONMENT POLLUTION 3

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

UNIT III NATURAL RESOURCES 3

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 3

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 3

Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS – women and child welfare – role of information technology in environment and human health

(A) AWARENESS ACTIVITIES: 15

i) small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

(B) ACTUAL ACTIVITIES:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).

REFERENCES

1. Vairamani, S. and Dr. K. Sankaran. **Elements of Environmental and Health Science.**Karaikudi: KPSV Publications, 5th Edition, July 2013.
2. Ifthikarudeen, Etal, **Environmental Studies**, Sooraj Publications,2005.
3. R.Murugesan, **Environmental Studies,** Millennium Publishers and Distributors, 2nd Edition,July, 2009.

Course Code: EBBT22ID2	Course Name: HUMAN ANATOMY AND PHYSIOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn basics of cell and tissue
- To study about the positioning and functioning of the skeletal and muscular system
- Describe the structure, function of cardiovascular system and respiratory system
- Discuss the structure of digestive and excretory system.
- Describe the physiological process of Nervous and sensory system

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand basics of cell and tissue
CO2	Able to understand positioning and functioning of the skeletal and muscular system
CO3	Familiarize the structure, function of cardiovascular system and respiratory system
CO4	Able to understand the structure of digestive and excretory system.
CO5	Able to understand the physiological process of Nervous and sensory system

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	3	3	2
CO3	1	2	1
CO4	2	3	2
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
										✓		

Course Code: EBBT22ID2	Course Name: HUMAN ANATOMY AND PHYSIOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I CELL AND TISSUE STRUCTURE 9

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions

UNIT II SKELETAL AND MUSCULAR SYSTEM 9

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

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM 9

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

UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS 9

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

UNIT V NERVOUS AND SENSORY SYSTEM 9

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

Total No of Periods: 45

TEXT BOOKS:

1. Elaine.N. Marieb, “Essential of Human Anatomy and Physiology”, Ninth Edition, Pearson Education, New Delhi, 2018.
2. 2. Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”, Third edition Springer, 2006. (Unit 2,3,4)

REFERENCE BOOKS:

1. Guyton & Hall, “Text book of Medical Physiology”, 13th Edition, Saunders, 2015.
2. Ranganathan T S, “Text book of Human Anatomy”, S.Chand& Co. Ltd., New Delhi, 2012.
3. SaradaSubramanyam, K MadhavanKutty, Singh H D, “Textbook of Human Physiology”, S. Chand and Company Ltd, New Delhi, 2012.

Course Code: EBBM22002	Course Name: Analog and Digital Electronics	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

COBJECTIVES

- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- To know the Digital fundamentals, Boolean algebra, K-Map
- To introduce the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for sequential logic circuits

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Design analog linear circuits and develop linear IC based Systems.
CO2	Apply the concept of ADC and DAC in real time systems and Phase Locked Loop with applications.
CO3	Know Boolean algebra and apply it to digital systems.
CO4	Design various combinational digital circuits using logic gates.
CO5	Analysis and design procedures for synchronous and asynchronous sequential circuits.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	2	3	3	2	1			
CO2	3	2	2	3	2			
CO3	3	2	1	2	3			
CO4	2	2	3	3	1			
CO5	3	3	2	2	1			

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22002	Course Name: Analog and Digital Electronics	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS 9

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

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

Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

UNIT III BASIC GATES ANDCOMBINATIONAL CIRCUITS 9

Number Systems, 1‘s and 2‘s complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of Product and Product of Sum, Minterms and Maxterms, Karnaugh map

UNIT IV COMBINATIONAL LOGIC CIRCUITS 9

Design of combinational circuits - Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Mu1tiplexer, Demultiplexer, Decoder, Encoder, Priority Encoder, Code-Converters.

UNIT V SEQUENTIAL LOGIC CIRCUITS 9

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

TOTAL:45 PERIODS

TEXT BOOKS

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

REFERENCES

1. Taub and Schilling, “Digital Integrated Electronics”, Mc Graw Hill, 2017.
2. Charles H.Roth, Jr, “Fundamentals of Logic Design”, Jaico Books, 7th Edition, 2013.
3. M. Morris Mano and Michael D.Ciletti, “Digital Design”, Pearson, 5th Edition, 2013.
4. S Salivahanan and V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education, 3rd Edition, 2018

Course Code: EBBM22003	Course Name: BIOMEDICAL INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- The student will study about electrodes types and bio potential generation.
- The students try to understand the basic principles in signal conditioning circuits.
- The student will acquire basic knowledge in measurement of non-electrical parameters
- To educate on introduction to biosignal characteristics
- To introduce the phenomenon of biochemical measurement

COURSE OUTCOMES (COs): (3- 5)

CO1	The graduate will be able to study about electrodes types and bio potential generation.
CO2	Understands the basic principles in signal conditioning circuits.
CO3	Acquires basic knowledge in measurement of non-electrical parameters.
CO4	The graduate understands the bio signal characteristics.
CO5	Learns the phenomenon of biochemical measurement.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	3
CO3	1	2	3
CO4	2	2	3
CO5	2	2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22003	Course Name: BIOMEDICAL INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNITI BIO POTENTIAL GENERATION AND ELECTRODESCONFIGURATIONS 9

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

UNIT II BIOSIGNAL CHARACTERISTICS 9

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

UNIT III BIOAMPLIFIERS 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 BIO SIGNALS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods and direct methods. Blood flow measurement and cardiac output measurement.

UNIT V BIOCHEMICAL MEASUREMENT 9

Blood glucose sensors, Blood gas analyzers, ISFET, colorimeter, flame photometer, Spectrophotometer, blood cell counter, auto analyzer, Sodium Potassium Analyser

Total No of Periods: 45

TEXT BOOKS:

1. John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015.
2. Leslie Cromwell, Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015

REFERENCE BOOKS:

1. Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw-Hill New Delhi, 2014
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004.

Course Code: EBBT22ID3	Course Name: PATHOLOGY AND MICROBIOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To learn about Normal cell structure
- To gain knowledge on Fluid and heamodynamic derangement
- To study about Genetic disorders
- To acquire knowledge on General structural organization
- To be able to do Identification of disease producing organism

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands Normal cell structure
CO2	Gets knowledge on Fluid and heamodynamic derangement
CO3	Familiar about Genetic disorders
CO4	Acquires knowledge on General structural organization
CO5	Performs Identification of disease producing organism

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	2	1	2
CO3	1	2	3
CO4	3	2	1
CO5	2	1	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
										✓		

Course Code: EBBT22ID3	Course Name: PATHOLOGY AND MICROBIOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I NORMAL CELL STRUCTURE 9

Cell Structure & Function, Different Types of Cells-Prokaryotic cells: Bacteria, cyano-bacteria Eukaryoticcells: Plants, animals, fungi, protozoans. Tissues and muscles. Cell Degeneration and regeneration -Classification- Difference between benign and malignant tumors - Etiology of tumors-Case Studies

UNIT II CELL DEGENERATION, REPAIR AND NEOPLASIA 9

Cell injury and necrosis, apoptosis, intracellular accumulations, cellular adaptations of growth and differentiation. Inflammation and repair including fracture healing, neoplasia, benign and malignant tumours, spread of tumours and biopsy. Visualization of histopathological slides of benign and malignant tumours.

UNIT III HEAMODYNAMIC DERANGEMEN AND GENETIC DISORDERS 9

Edema -Shock -Hemorrhage - Thrombus - Embolism- Disseminated intra vascular Coagulation - Hematological disorders- Bleeding Disorders - Leukemia - lymphoma . Genetic disorders – immunity Autosomal and sex-linked disorders - Storage disorders - types of hypersensitivity reactions– helminthic disease- Case study

UNIT IV IDENTIFICATION OF PATHOGENS 9

General structural organization of Bacterial -Viral Cell -Identification and growth of Bacteria and virus-Observation of culture – Microscopy - Light Microscopy - Dark field Microscopy - electron microscopy .Identification of disease producing organism - types of Stain -Fluorescent techniques -Antigen – Antibody Techniques and its applications.

UNIT V IMMUNOLOGY 9

Natural and artificial immunity, phago cytosis, inflammation, antibodies, antigen and antibody reactions, hypersensitivity, immunological techniques- immune diffusion, immune electrophoresis, radio immunoassay and enzyme linked immuno sorbent assay, monoclonal antibodies. Diseasecaused by bacteria and protozoa. Visualization of slides of malarial parasites, microfilaria and leishmania donovani.

Total No of Periods: 45

TEXT BOOKS:

1. Robbins &Cotran Pathologic Basis of Disease, 10th Edition - May 18, 2020
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of diseases”, WB Saunders Co. 7th Edition, 2005.
3. Harsh Mohan, “Text book of Pathology”. Jaypee Brothers Medical publishers private Limited, 7th Edition, 2014.

REFERENCE BOOKS:

1. Underwood JCE, “General and Systematic Pathology”, Churchill Livingstone, 3rd, Edition, 2000.
2. Ananthanarayanan, “Microbiology”, Panicker University press. 9th Edition, 2013
3. Dubey RC and MaheswariDK , “Microbiology”, S Chand Publications, 3th Edition, 2010
4. Prescott, Harley,Klein, “Microbiology”, Mc Graw Hill, 9th Edition, 2013.

Course Code: EBBT22ID4	Course Name: BIO-CHEMISTRY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To study about biochemistry of living cell
- To study about enzymes
- To study about carbohydrate and lipids
- To study blood and blood fluid
- To emphasis the diagnostic tool

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Understand the biochemistry of living cell
CO2	Know about the enzymes
CO3	Acquire knowledge in carbohydrate and lipids
CO4	Understand the blood and blood fluid
CO5	Know about diagnostic tool

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**2**	**1**	**1**	**1**	**3**	**2**	**1**	**2**	**3**	**2**
CO2	**3**	**3**	**2**	**1**	**3**	**2**	**3**	**1**	**2**	**3**	**2**	**1**
CO3	**2**	**3**	**2**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO4	**2**	**3**	**2**	**3**	**1**	**2**	**2**	**3**	**2**	**1**	**3**	**2**
CO5	**3**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**

COs / PSOs	PSO1	PSO2	PSO3
CO1	**2**	**3**	**2**
CO2	**3**	**2**	**2**
CO3	**3**	**2**	**1**
C04	**2**	**1**	**3**
CO5	**1**	**2**	**3**

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
										✓		

Course Code: EBBT22ID4	Course Name: BIO-CHEMISTRY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I BIOCHEMISTRY OF LIVING CELL 9

Biochemistry of living cell -sub cellular fractionation using the differential centrifugation method - Function of each organelle Redox Potential -Oxidative Phosphorylation -Transport of substances a cross biological membrane - NUCLEAR ACID: Composition and Function, Genes -Outline of DNA structure -Re-combinant DNA

UNIT II ENZYMES 9

Chemical Nature -General Properties -Spectrophotometric measurement of enzymes -Isolation techniques -Diagnostic enzymes - Enzyme biotechnology - Hormones: Chemical Nature -Properties of hormones -Hormonal Assay and their significance

UNIT III CARBOHYDRATE AND LIPIDS 9

Carbohydrate – Classification, Metabolism of carbohydrateand its dysfunction -uses of Carbohydrates - Lipids: Classification -Metabolism of lipids -Cholesterol -bile acids -Transport of lipids -Lipids metabolism dysfunction. Protein: Classification- Amino acids- Chromatography- electrophoresis and architecture of protein molecules and its applications

UNIT IV BIO CHEMISTRY OF BLOOD AND BODY FLUIDS 9

Liver Function tests -Renal Function Tests -Blood gas Analysis -Measurement of Electrolytes -their abnormal and Normal values and conditions - Biochemistry of Urine and Stools testing

UNIT V DIAGNOSTIC TOOL 9

Principles and Application of Photometry -Spectrophotometry -Fluorometry -Photometry-Densitometry -calorimetry -Automation in clinical Laboratory - Use of Isotopes in Biochemistry

Total No of Periods: 45

TEXT BOOKS:

1. Dr. Amniga Shanmugam, “Fundamentals ofBiochemistry for Medical Students”, Karthic Printers, Madras, 1997

REFERENCE BOOKS:

1. Jain J, Jain L, Nitin Sunjay Jain, “Fundamentals of Biochemistry,” Chand. S Group, ISBN: 8121924537.
2. Satyanarayana U, and Chakrapani U, “Biochemistry”, Books and Allied (p) Ltd., ISBN: 8187134801

Course Code: EBCC22ET1	Course Name Universal Human Values: Understanding harmony	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	1	0/0	2/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- Development of a holisti perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society andnature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Relate self and surroundings and identify responsibility in life
CO2	Associate human relationship and nature to handle problems and provide sustainable solutions
CO3	Develop critical ability and engage in reflective and independent Thinking
CO4	Show commitment towards understanding of values
CO5	Apply Human values in day to day setting in real life

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	-	-	**1**	**1**	-	**2**	**1**	-	**1**	**1**	-	**2**
CO2	-	-	**2**	**2**	**1**	**2**	**3**	**1**	-	**2**	-	**2**
CO3	-	-	**1**	**1**	**1**	**2**	-	-	**1**	**2**	-	**3**
CO4	-	-	**2**	-	**1**	**1**	**1**	**3**	**1**	**1**	-	**3**
CO5	-	-	**1**	-	-	**2**	**1**	**2**	**1**	**1**	-	**3**

COs / PSOs	PSO1	PSO2	PSO3
CO1	**3**	**2**	**3**
CO2	**2**	**2**	**3**
CO3	**3**	**2**	**2**
C04	**3**	**1**	**2**
CO5	**2**	**2**	**1**

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
			✓									

Course Code: EBCC22ET1	Course Name Universal Human Values: Understanding harmony	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	1	0/0	2/0	2

UNIT I INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 9

Purpose and motivation for the course, recapitulation from Universal Human Values-I - Self- Exploration–what is it? - Its content and process; 'Natural Acceptance and Experiential Validation- as the process for self-exploration. – Continuous Happiness and Prosperity-A look at basic HumanAspirations - Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority –Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario – Method tofulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF! 9

Understanding human being as a co-existence of the sentient 'I' and the material'Body - Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP 9

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust;Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship - Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude asa universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE 9

Understanding the harmony in the Nature - Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence asCo-existence of mutually interacting units in all-pervasive space - Holistic perception ofharmony at all levels of existence - Include practice sessions to discuss human being as cause ofimbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. - Case studies of typical holistic technologies, management models and production systems - Strategy for transition fromthe present state to Universal Human Order: ((a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, (b)At the level of society: as mutually enriching institutions and organizations - Sum up

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Total No of Periods: 45

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks,New Delhi, 2010

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Course Code: EBBT22IL2	Course Name: HUMAN ANATOMY AND PHYSIOLOGY LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To study the various human system
- To test hearing capacity
- To test various parameters of vision
- To learn method to identify the blood groups
- To estimate hematological parameters

COURSE OUTCOMES (COs): (3- 5)Students will be able to

CO1	Know the various human system
CO2	Test hearing capacity
CO3	Test various parameters of vision
CO4	Identify the blood groups
CO5	Estimate hematological parameters

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	2	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBT22IL2	Course Name: HUMAN ANATOMY AND PHYSIOLOGY LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Study of human skeleton system
2. Study of human muscular and nervous system
3. Study of human urinary system
4. Study of human joint system
5. Studyof human sense organ system
6. Study of human respiratory system and reproductive system
7. Testing of Hearing using Tuning Fork.
8. Testing of various parameters of Vision and Errors of Refraction.
9. Identification of Blood groups
10. Bleeding and Clotting time
11. Estimation of Hemoglobin
12. Total RBC Count and WBC Count

Total No of Periods: 45

Course Code: EBBM22L01	Course Name: ANALOG AND DIGITAL ELECTRONICS LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To acquire the knowledge in characteristics of OP-AMP
- To acquire the knowledge in applications of OP-AMP
- To acquire the knowledge in basics of digital electronics
- To design combinational circuits
- To simulate and analyse using software

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Acquire the knowledge in characteristics of OP-AMP
CO2	Acquire the knowledge in applications of OP-AMP
CO3	Acquire the knowledge in basics of digital electronics
CO4	Design combinational circuits
CO5	Simulate and analyze using software

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	3	2
CO3	3	2	3
CO4	2	2	3
CO5	2	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L01	Course Name: ANALOG AND DIGITAL ELECTRONICS LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Design and analysis of active filters
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier
6. Study of logic gates, Half adder and Full adder
7. Code converters
8. Encoder and BCD to 7 segment decoder
9. Multiplexer and demultiplexer using digital ICs
10. Simulation and analysis of circuits using software

Total No of Periods: 45

Course Code: EBBM22L02	Course Name: BIOMEDICAL ELECTRONICS AND INSTRUMENTATION LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Engineering	Lb	0	0/0	3/0	1

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- Able to improve the knowledge in electrical circuits and theorems
- Able to analyze the electronics circuits characteristics and its application
- Able to design different bio amplifiers,
- Able to measure blood pressure
- Able to measure blood flow

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Improve the knowledge in electrical circuits and theorems
CO2	Analyze the electronics circuits characteristics and its application
CO3	Design different bio amplifiers
CO4	Measure blood pressure
CO5	Measure blood flow

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	3	2
CO3	3	2	3
CO4	2	2	3
CO5	2	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L02	Course Name: BIOMEDICAL ELECTRONICS AND INSTRUMENTATION LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Electrical and Electronics Engineering	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Verification of Thevenin's and Norton's Theorems.
2. Characteristics of PN and zener diode.
3. Half wave and Full wave rectifier with capacitor filter.
4. Voltage regulation using zener diode.
5. Characteristics of Amplifier in CE,CB and CC Configuration
6. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
7. Design of EMG amplifier
8. Design of frontal EEG amplifier
9. Measurement of blood pressure using sphygmomanometer.
10. Measurement and recording of peripheral blood flow

Total No of Periods: 45

Course Code: EBBT22IL3	Course Name: BIO-CHEMISTRY LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study Laboratory Safety and Hygiene.
- To study the use of instruments
- To analysis nutrients.
- To analyze the amino acid.
- To measure pH value of solution.

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Know about Laboratory Safety and Hygiene.
CO2	Study about the use of instruments
CO3	Analyze nutrients.
CO4	Analyze the amino acid.
CO5	Measure pH value of solution.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	2	1	1	3	2	1	2
CO2	2	3	2	1	3	2	1	3	2	1	2	3
CO3	3	2	1	1	2	3	2	1	2	1	2	2
CO4	1	1	3	3	2	1	2	1	3	2	3	1
CO5	1	3	2		2	3	2	1	3	2	1	2

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	3	2	2
CO3	1	2	3
CO4	3	2	3
CO5	1	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBT22IL3	Course Name: BIO-CHEMISTRY LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Laboratory Safety and Hygiene: Standard Operating Procedures, Units and Measurements, basic statistical concepts for biochemical analysis.
2. Use of Instruments, pH and Buffers.
3. Qualitative analysis of Carbohydrates.
4. Qualitative analysis of Proteins.
5. Qualitative analysis of Amino acids and lipids.
6. Determination of pK and pI value of amino acid.
7. Estimation of amino acids by ninhydrin method.
8. Separation of proteins by SDS electrophoresis
9. Separation of amino acids by thin layer chromatography
10. Measurement of pH of solutions using pH meter.

Total No of Periods: 45

Course Code: EBMA22009	Course Name: **LAPLACE TRANSFORM AND FOURIER TRANSFORM**	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research
C:CreditsT/L/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To study the Basic concepts in Laplace Transforms
- To study the Applications of Laplace Transforms
- To study the Basic concepts in Fourier series
- To study the Basic concepts in Fourier Transforms
- To study the Basic concepts in Z Transforms

COURSEOUTCOMES(Cos)Students will be able to

CO1	To understand the Basic concepts in Laplace Transforms
CO2	To understand the Applications of Laplace Transforms
CO3	To understand the Basic concepts in Fourier series
CO4	To understand the Basic concepts in Fourier Transforms
CO5	To understand the Basic concepts in Z Transforms

Mapping of Course Outcome with Program Outcome(POs)

Cos/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	**1**	**1**	-	**2**	**1**	-	**1**	**1**	-	**2**
CO2	-	-	**2**	**2**	**1**	**2**	**3**	**1**	-	**2**	-	**2**
CO3	-	-	**1**	**1**	**1**	**2**	-	-	**1**	**2**	-	**3**
CO4	-	-	**2**	-	**1**	**1**	**1**	**3**	**1**	**1**	-	**3**
CO5	-	-	**1**	-	-	**2**	**1**	**2**	**1**	**1**	-	**3**

COs /PSOs	PSO1	PSO2	PSO3		
CO1	**3**	**2**	**3**		
CO2	**2**	**2**	**3**		
CO3	**3**	**2**	**2**		
CO4	**3**	**1**	**2**		
CO5	**2**	**2**	**1**		

3/2/1IndicatesStrength OfCorrelation,3–High,2-Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
	✓											

Course Code: EBMA22009	Course Name: **LAPLACE TRANSFORM AND FOURIER TRANSFORM**	Ty /Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

UNIT I LAPLACE TRANSFORMS 12

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals.

UNIT II APPLICATIONS OF LAPLACE TRANSFORMS 12

Periodic functions – Initial and final value theorems – Convolution theorem –Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

UNIT III FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series –Parseval's identity –Harmonic Analysis.

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

UNIT V Z TRANSFORMS AND DIFFERENCE EQUATION 12

Z-transforms – Elementary properties – Inverse Z transforms – Partial fraction – Residue method – Convolution theorem – Solution of difference equation using Z transform(simple problems).

Total No of Periods: 60

Reference Books:

1. Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).
2. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co., (2005).
3. Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, (2017).
4. Kreyszig E., Advanced Engineering Mathematics (9 th ed.), John Wiley & Sons, (2011).
5. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).

Course Code: EBBM22004	Course Name: BIOPHYSICAL SIGNALS & SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To impart knowledge on various signals and systems
- To analyze the signals using different transforms
- To know about sampling of signal and different noises
- To understand filtering techniques
- Knowledge on Physiological Systems

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Recognize the Signals and systems
CO2	Analyze the signals using different transforms
CO3	Get knowledge on sampling and noises
CO4	Understand filtering techniques
CO5	Know about physiological systems

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	3
CO3	3	1	2
CO4	3	2	1
CO5	3	1	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22004	Course Name: BIOPHYSICAL SIGNALS & SYSTEMS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

UNIT I SIGNALS AND SYSTEMS 12

Continuous time (CT) signals, Discrete time (DT) signals, periodic, aperiodic, random, energy and power signals, step, ramp, impulse and exponential function, Transformation in independent variable of signals: time scaling, time shifting and time inverting.

Introduction to systems, system properties, interconnection of system, LTI systems- linear and circular convolution, correlation, auto-correlation, direct form-I and direct form-II representations, parallel and cascade representations, physiological signals and their properties.

UNIT II SIGNAL ANALYSIS 12

Basic concepts of the Fourier Series, Properties of continuous and discrete time Fourier Series, Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT), Discrete Fourier transform (DFT) and its inverse (IDFT),

UNIT III FFT AND NOISE 12

Introduction to Fast Fourier transform (FFT), Sampling theorem, Reconstruction of a Signal from its samples, aliasing. Sources and types of noise.

UNIT IV FILTERING TECHNIQUES 12

Types of filter (Active and Passive), General idea of LPF, HPF, BPF and Notch Filter. Passive and Active Filters, use of filter for biomedical signal analysis, design of filter suitable for Bio-medical signal analysis

UNIT V PHYSIOLOGICAL SYSTEM 12

Block diagram representation of cardio vascular system, Electrical analog of blood vessels and its transfer function. Characteristics of ECG, EEG and EMG signals, signal conditioning of these bio-potential signals

Total No of Periods: 60

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2nd edition, 2007
2. Anil Baran Singha Mahapatra, “Essential of Medical Physiology”, Current Books International
3. C.C. Chatterjee, “Human Physiology “. Medical Allied Agency

REFERENCE BOOKS:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford,2009.
2. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
3. M.J.Roberts, “Signals & Systems Analysis using Transform Methods & MATLAB”,TataMcGrawHill, 2007.
4. J. Gibson, “Modern Physiology and Anatomy for Nurses”, Black-well Scientific Publishers

Course Code: EBBM22005	Course Name: BIO SENSORS AND TRANSDUCERS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To make the students understand the fundamental knowledge of transducers.
- To study the principle and working of various transducers.
- To develop skills among students for measurement of biological parameters.
- To acquire knowledge on different bio potential electrodes
- To acquire knowledge on advanced sensors.

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Analyze functioning of transducers
CO2	Understand principle and working of various transducers
CO3	Measure biological parameters.
CO4	Gain knowledge about different electrodes.
CO5	Gain knowledge about various advanced sensors

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	3	2	3
CO3	1	3	2
CO4	2	3	3
CO5	3	1	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22005	Course Name: BIO SENSORS AND TRANSDUCERS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION OF TRANSDUCERS 9

Basics of Various Biological Sensing Mechanisms in Human Body - Introduction to Transducers and Sensors –Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards.

UNIT II PRESSURE, DISPLACEMENT AND TEMPERATURE TRANSDUCER 9

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gauge – Potentiometer - How wire Anemometer -Capacitive transducer - Inductive transducer – LVDT – RTD – Thermistor – Thermocouple.

UNIT III MEASUREMENT OF BIOLOGICAL PARAMETERS 9

Units of Pressure - Requirement for Pressure Measurement - Physiological Ranges for Pressure Measurement - Reference Points for Pressure Measurement - Direct Pressure Measurement– Detection of Korotkoff's Sound - Indirect Pressure Measurement - Indirect Measurement of Instantaneous Arterial Pressure -Electromagnetic Flow Meter and Ultrasound Flow Meter.

UNIT IV BIO POTENTIAL ELECTRODES 9

Transducers for Ions and Dissolved Gases - Half-Cell Potential - Reference Electrodes - Hydrogen Electrodes - Silver-Silver Chloride Electrodes- Calomel Electrodes - Measurement of pH- Measurement of pO_2 - Measurement of pCO_2 - Measurement of Conductivity

UNIT V INTELLIGENT SENSORS, OPTICAL AND ULTRASOUND SENSORS 9

Intelligent Sensors: Definition, parameters, features, operating principle, main building blocks and applications. Optical techniques, General principles of optical sensing, Fiber-optic basics, Fiber-optic sensor technologies and applications. Fundamentals of ultrasonic-based sensors, Ultrasonic-based sensing methods and applications.

Total No of Periods: 45

TEXTBOOKS

1. Webster, J.G., 2009. Medical instrumentation application and design. John Wiley & Sons.
2. Togawa, T., Tamura, T. and Oberg, P.A., 1997. Biomedical transducers and instruments. CRC press.
3. Patranabis, D, "Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi, 1997

REFERENCE BOOKS

1. Geddes, L.A., 1968. Principles of applied biomedical instrumentation. John Wiley & Sons.
2. Cobbold, R., 1978. Transducers for Biomedical Measurements. Journal of Clinical Engineering, 3(3), p.306.
3. Norton, H.N., 1982. Biomedical sensors, fundamentals and applications. Noyes Publications.
4. Yang, V. C., and Ngo, T. T., (2000), Biosensors and their Applications, Kluwer Academic/Plenum Publisher, New York.
5. Harsanyi, G , (2000), Sensors in Biomedical Applications: Fundamentals, Technology and Applications, Technomic Publishing Company

Course Code: EBBM22006	Course Name: MICROPROCESSOR AND MICROCONTROLLER FOR BIOMEDICAL ENGINEERS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand the Architecture of 8085 microprocessor.
- To interface microprocessors with supporting chips.
- To understand the Architecture of 8051 microcontroller.
- To design a microcontroller-based system
- To understand the Architecture of PIC

COURSE OUTCOMES (COs) : (3- 5) Students will be able to:

CO1	Understand the Architecture of 8085 microprocessor.
CO2	Interface microprocessors with supporting chips.
CO3	Understand the Architecture of 8051 microcontroller.
CO4	Design a microcontroller-based system
CO5	Understand the Architecture of PIC

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	1	3	3
CO4	1	2	2
CO5	2	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22006	Course Name: MICROPROCESSOR AND MICROCONTROLLER FOR BIOMEDICAL ENGINEERS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I 8085 PROCESSOR **9**

Functional block diagram - Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions, subroutine and stack

UNIT IIPERIPHERAL INTERFACING **9**

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 - A/D and D/A converter interfacing

UNIT III MICRO CONTROLLER 8051 **9**

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports – Serial communication. Data Transfer, Manipulation, Control & I/O instructions

UNIT IVMICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Simple programming exercises key board and display interface- interfacing an LCD- interfacing to ADCinterfacing a DAC, Sensors – Closed loop control of servo motor- interfacing a stepper motor

UNIT V INTRODUCTION TO ARM PROCESSORS **9**

Basic ARM architecture – ARM assembly language program – ARM organization and implementation– The ARM instruction set - The thumb instruction set – ARM CPU cores

Total No. of Periods: 45

Text books:

1. Gaonkar, R.S (2006) Microprocessor Architecture Programming and Application. New Delhi: Wiley Eastern Ltd
2. Muhammad Ali Mazidi, & Janice GilliMazidi, (2003) The 8051 Micro Controller and Embedded Systems. 5th Indian reprint, Pearson Education
3. Steve Furber,(2000) ARM System –On –Chip architecture. Addison Wesley

Reference books:

1. William Kleitz, (2006) Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software. Pearson Education
2. Daniel Tabak, Advanced Daniel Microprocessors. McGraw Hill Inc

Course Code: EBBM22ET1	Course Name :BIO CONTROL SYSTEM	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To interpret the need for mathematical modelling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems
- To determine the time response of various systems
- To discuss the concept of system stability
- To examine the frequency response characteristics of various systems using different charts
- To Appraise the concept of modelling basic physiological systems

COURSE OUTCOMES (COs) : (3- 5) Students will able to

CO1	Interpret the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems
CO2	Determine the time response of various systems
CO3	Discuss the concept of system stability
CO4	Examine the frequency response characteristics of various systems using different charts
CO5	Appraise the concept of modeling basic physiological systems

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	3	2	1
CO3	2	3	2
CO4	3	2	1
CO5	3	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22ET1	Course Name :BIO CONTROL SYSTEM	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

UNIT I CONTROL SYSTEM MODELING 12

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

UNIT II TIME RESPONSE ANALYSIS 12

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

UNIT III STABILITY ANALYSIS 12

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

UNIT IV FREQUENCY RESPONSE ANALYSIS 12

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

UNIT V BIOLOGICAL CONTROL SYSTEM 12

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

Lab Components:

1. Design and analyze any closed loop system.
2. Determine the time domain specifications for first order system.
3. Determine the time domain specifications for second order system.
4. Design and construct the root locus for a system to analyze the stability
5. Analyze the stability of a system using bode plot
6. Analyze the stability of a system using polar plot

Total No of Periods: 60

TEXT BOOKS:

1. I.J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1stSeptember, 2018.
2. Michael C K Khoo, Physiological Control Systems, IEEE Press, Prentice Hall India, 2005.

REFERENCE BOOKS:

1. Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control Systems Engineering, Pearson Education India, 2015.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3. Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice-Hall, 2002.

Course Code: EBBM22L03	Course Name: BIOSENSORS AND TRANSDUCERS LABORATORY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To learn practically about transducers and about the types of Transducers
- To study various transducers used for the measurement of various physical Quantities
- To identify suitable instruments to meet the requirements of industrial applications
- To measure Resistive, Capacitive and Inductive transducers
- To calibrate various transducers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Enables the students to practically know about transducers and about the types of Transducers
CO2	Various transducers used for the measurement of various physical Quantities
CO3	The student can identify suitable instruments to meet the requirements of industrial applications
CO4	The graduate can measure Resistive, Capacitive and Inductive transducers
CO5	Graduate can calibrate various transducers

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	3
CO3	2	3	3
CO4	3	3	2
CO5	2	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L03	Course Name: BIOSENSORS AND TRANSDUCERS LABORATORY	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Strain Gauge Measurement
2. LVDT With Measurement of Displacement
3. Piezo Electric Transducer with Apnea Detection
4. Opto Coupler Pulse Rate Measurement
5. Pressure Transducer for Invasive BP Measurement.
6. Pressure Transducer for Non-Invasive BP Measurement.
7. Ultra Sound Transducers Fetal Doppler.
8. Ultra Sound Therapy
9. GSR Measurement.
10. Body Temperature Measurement.

Total No of Periods: 45

Course Code: EBBM22L04	Course Name: MICROPROCESSOR AND MICROCONTROLLER LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To familiarize 8085 Microprocessor kit and 8051 Microcontroller kit
- To understand the programming concepts of microcontroller.
- To interface the microcontroller/microprocessor with peripherals.
- To study MASM and DEBUG utilities
- To study ARM Processor

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Get knowledge on 8085 Microprocessor kit and 8051 Microcontroller kit
CO2	Understand the programming concepts of microcontroller.
CO3	Interface the microcontroller/microprocessor with peripherals.
CO4	Know about MASM and DEBUG utilities
CO5	Know about ARM Processor

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	1	3	2	3	2
CO2	3	3	3	2	2	1	1	1	2	1	2	1
CO3	3	3	3	3	3	3	2	2	3	2	3	2
CO4	3	3	3	3	3	2	2	2	3	2	3	2
CO5	3	3	3	3	3	2	2	2	3	2	3	2

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	1	2	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L04	Course Name: MICROPROCESSOR AND MICROCONTROLLER LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Familiarization of 8085 Microprocessor kit and 8051 Microcontroller kit
2. Write a Program for addition, Subtraction, Multiplication and division.
3. Write a Program for Ascending/Descending Order.
4. Write a Program for A/DConverter
5. Write a Program for D/A Converter
6. Write a Program to interface switches and display devices
7. Write a Program to interface key board and display
8. Write a Program to interface programmable Timer
9. Write a Program to interface Stepper motor
10. Write a Program to interface Traffic light controller
11. Study of MASM and DEBUG utilities
12. Study of ARM Processor

Total No of Periods: 45

Course Code: EBBM22L05	Course Name :CALIBRATION LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basic concept of calibration.
- To demonstrate calibration procedure for mass, volume, speed and pressure
- To demonstrate error factors to be taken for uncertainty calculations.
- To perform calibration procedures of medical equipment.
- To perform electrical safety test for medical equipment.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate is capable tounderstand the basic concept of calibration
CO2	Capable demonstrate calibration procedure for mass, volume, speed and pressure
CO3	Capable to demonstrate error factors to be taken for uncertainty calculations.
CO4	Capable to perform calibration procedures of medical equipment.
CO5	Capable to perform electrical safety test for medical equipment.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	1	2	1
CO4	3	2	2
CO5	2	1	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L05	Course Name :CALIBRATION LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Basic concept of calibrations and Traceability.
2. Calibration Procedure of Mass, Volume, Speed & Pressure.
3. Practical Demonstration on Mass, Volume, Speed & Pressure.
4. Error factors to be taken for uncertainty calculations- Mass, Volume, Speed & Pressure.
5. Calibration Procedure in Temperature & Relative Humidity.
6. Practical training on Temperature & Relative Humidity.
7. Error factors to be taken for uncertainty calculations- Temperature & Relative Humidity
8. Calibration Procedure in Medical Devices
9. Practical training on Medical Device Calibration.
10. Error factors to be taken for uncertainty calculations-Medical Devices
11. Electrical Safety Test for Medical Equipment
12. Training Evaluation & Feedback

Total No of Periods: 45

Course Code: EBBM22I01	Course Name: TECHNICAL SKILLS 1	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
								✓				

Course Code: EBBM22I01	Course Name: TECHNICAL SKILLS 1	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0/0	2/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Course Code: EBCC22I06	Course Name :SOFT SKILLS I - EMPLOYABILITY SKILL	TY/LB/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Pass Marks in Plus 2 English	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Cultivate employability skills that they get employed even before they leave the university.
- Build self-esteem and a sense of self-worth to be good team members
- Cultivate empathy to think from others' point of view to be good team leaders.
- Evolve as good global citizens with insights into social and professional ethics.
- Develop lifelong learning skills to adapt in the multicultural context of workplaces.

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Have the skills to get employed even before they leave the university.
CO2	Have self-esteem and a sense of self-worth to be good team members
CO3	Have cultivated empathy to think from others' point of view to be good team leaders.
CO4	Evolve as good global citizens with insights into social and professional ethics.
CO5	Develop lifelong learning skills to adapt in the multicultural context of workplaces.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	3	1	1	2	3	3	1	3
CO2	-	1	-	2	3	2	1	1	3	3	-	3
CO3	1	1	1	1	2	1	-	2	3	3	1	3
CO4	1	2	1	1	3	-	1	-	2	2	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	2	2	1	2			
CO2	1	2	2	2			
CO3	2	2	3	3			
CO4	2	2	3	3			

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
									✓			

Course Code: EBCC22I06	Course Name :SOFT SKILLS I - EMPLOYABILITY SKILL	TY/LB/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Pass Marks in Plus 2 English	IE	0	0/0	2/0	1

Unit -I (LSRW)

Conversational skills: Essential skills to sustain conversation- non-verbal communication – body language - gestures, gambits- paralanguage-Role plays – Skeleton dialogues- Dialogue writing- telephone etiquette- pragmatics in communication – speech styles for effective communication

Unit -II

Self-esteem skills-empathy-public relations-positivity-reliability-professionalism

Unit -III

Leadership skills – importance of interaction in group management- analytical skill-conflict management-problem solving

Unit -IV

Intercultural communication skills- familiarising global culture-Cultural sensitivity-Cultural intelligence: Low and High context, e mail and inter cultural communication

Unit -V

Job and career- three types- Govt.-private and public sector – competitive exams -Group discussion &Interview skills

Suggested reading

1. S.P. Dhanavel, English and Soft Skills, Vol.2 Orient BlackswanPvt. Ltd. 2010
2. P.D. Chaturvedi and M. Chaturvedi, Communication Skills , Pearson, 2012

Course Code: EBBM22007	Course Name: DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Describe the working and recording setup of all basic cardiac equipment.
- Understand the working and recording of all basic neurological equipments.
- Discuss the recording of diagnostic and therapeutic equipments related to EMG.
- Explain about measurements of parameters related to respiratory system.
- Describe the measurement techniques of sensory responses.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires knowledge about cardiac system
CO2	Graduates gains knowledge on neurological system
CO3	Understands skeletal muscular system
CO4	Understands the measurements of parameters related to respiratory system
CO5	Acquires knowledge about the measurement techniques of sensory responses

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	2	3	1	2	3			
CO2	3	2	3	1	2			
CO3	1	2	1	3	2			
CO4	2	3	1	2	2			
CO5	2	3	1	2	3			

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22007	Course Name: DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I CARDIAC EQUIPMENT 9

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

UNIT II NEUROLOGICALANDMUSCULAR EQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG. Recording and analysis of EMG waveforms, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement.

UNIT III DIATHERMY 9

Instruments for surgery - principle of surgical diathermy - surgical diathermy machine - safety aspects in Electro-Surgical diathermy Units. Physiotherapy and electrotherapy equipment - High frequency heat therapy - short wave Diathermy - Microwave diathermy - Ultrasonic therapy unit - Pain relief through Electrical Stimulation - Bladder Stimulators - Cerebellar Stimulators.

UNIT IV EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTICTECHNIQUES 9

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameter. Principles of Cryogenic technique and its application, Endoscopy, Laparoscopy, Thermography

UNIT V RESPIRATORY MEASUREMENT SYSTEM 9

Mechanics of Respiration - Artificial Respiration - Ventilators - Types of ventilators - Classification of Ventilators - Pressure - volume - flow Diagrams - Modern ventilators - High frequency ventilators. Humidifiers - Nebulizers and Aspirators –Spirometer.

Total No of Periods: 45

TEXT BOOKS:

1. John G. Webster, ―Medical Instrumentation Application and Design‖, 4th edition, Wiley India PvtLtd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical Equipment Technology‖, Pearson education, 2012.

REFERENCES:

1. Myer Kutz, ―Standard Handbook of Biomedical Engineering & Design‖, McGraw Hill, 2003.
2. L.A Geddes and L.E.Baker, ―Principles of Applied Biomedical Instrumentation‖, 3rd Edition, 2008
3. Leslie Cromwell, ―Biomedical Instrumentation and Measurement‖, Pearson Education, New Delhi, 2007.
4. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rdedition,Tata McGraw-Hill, New Delhi, 2014.

Course Code: EBBM22008	Course Name: MEDICAL ROBOTICS & AUTOMATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To provide knowledge on Application of robotics in the field of health care
- Overview of the sensor requirements for localization and tracking in medical Application
- To Understand the design aspects of medical robots
- To understand the concepts of robotics in rehabilitation of limbs and brain machine interface
- To analyze the design, methodology and technological choices of medical robots

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Describe the types of medical robots and the concept of navigation and motion replication
CO2	Discuss about the sensors used for localization and tracking
CO3	Summarize the application of surgical robots
CO4	Outline the concepts in Rehabilitation of limbs and brain machine interface
CO5	Analyze the design characteristics, methodology and technological choices for medical robots

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	2
CO3	3	3	2
CO4	2	3	3
CO5	2	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22008	Course Name: MEDICAL ROBOTICS & AUTOMATION	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	1/0	0/0	4

UNIT 1 INTRODUCTION TO MEDICAL ROBOTICS **12**

Introduction to medical robotics (applications and paradigms) - Basic kinematics concepts (forward, inverse, remote center of motion) - Basic control concepts (impedance, admittance) - Surgery for engineers - Interventional radiology for engineers - Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare

UNIT II MINIMALLY INVASIVE SURGERY (MIS) **12**

Human-machine interfaces- Teleoperation - Cooperative manipulation - Port placement for MIS - Robot design concepts - Video images in MIS - Augmented reality - Minimally invasive surgery training - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies.

UNIT III IMAGE-GUIDED INTERVENTIONS **12**

Medical imaging modalities (e.g., MRI, US, X-ray, CT) - Robot compatibility with medical imagers- Image segmentation and modeling -Tracking devices- Frames and transformations -Surgical navigation -Calibration -Rigid and non-rigid registration –Radiosurgery - Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems

UNIT IV CURRENT TRENDS IN MEDICAL ROBOTICS **12**

Existing clinical applications, controversies, and outcomes: - Cardiac, abdominal, and urologic procedures with teleoperated robots - Orthopaedic surgery with cooperative robots - Prostate interventions with manual “robots” - Robotic catheters for heart electrophysiology - Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles – case studies. Module 5: Robots In Medical Care, Assistive robots –types of assistive robots – case studies.

UNIT V MOBILE ROBOTS AND SECURITY **12**

Mobile robots in the body, Instrument-tissue interaction modeling, Autonomous robotic surgery. Other types of healthcare robots: Physically assistive robotics, Socially assistive robotics, Rehabilitation robotics. Characterization of gestures to the design of robots- Design methodologies- Technological choices - Security

Total No of Periods: 60

TEXT BOOKS:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modeling and Control”, Wiley Publishers, 2006.
2. Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.

REFERENCE:

1. Achim Schweikard, Floris Ernst, “Medical Robotics”, Springer, 2015.
2. Jocelyne Troccaz, “Medical Robotics”, Wiley-ISTE, 2012.
3. VanjaBonzovic, ”Medical Robotics”, I-tech Education publishing,Austria,2008.
4. Daniel Faust, “Medical Robots”, Rosen Publishers, 2016.
5. Jocelyne Troccaz, “Medical Robotics”, Wiley, 2013.

Course Code: EBBM22009	Course Name :ARTIFICIAL ORGANS AND IMPLANTS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To have an overview of artificial organs & transplants
- To describe the principles of implant design
- To explain the implant design parameters and solution
- To study about various blood interfacing implants
- To study about soft tissue replacement and hard tissue replacement

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Know about artificial organs & transplants
CO2	Describe the principles of implant design
CO3	To explain the implant design parameters and solution
CO4	Know about various blood interfacing implants
CO5	Get knowledge on soft tissue replacement and hard tissue replacement

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	2	2	3
CO3	2	1	1
CO4	3	2	1
CO5	1	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22009	Course Name : ARTIFICIAL ORGANS AND IMPLANTS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS 9

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

UNIT II PRINCIPLES OF IMPLANT DESIGN 9
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS 9
Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS 9
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

Total No of Periods: 45

TEXT BOOKS:

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

REFERENCE BOOKS:

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. ISBN:9780387952147.
5. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, ―Clinical Engineering‖, CRC Press, 1st edition,2010.
6. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw- Hill, 2003

Course Code: EBOL22I01	Course Name : ONLINE COURSE	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	1	0/0	1/0	1

Students should register for the online course with a minimum course duration of 4 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester. A mentor will be assigned by the department for monitoring the students.

Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester .Internal Examination will be conducted by the examiners duly appointed by the head of the department.

Course Code: EBBM22ET2	Course Name : EMBEDDED SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Microprocessor and Microcontroller	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The brief view of real time and embedded system.
- The graduates can understand the embedded system components and interface.
- Detailed overview about embedded system design and development.
- Analysis of real time system performance, language and their features.
- The case studies of safety, aerospace, automobile, medical and industrial application.

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Capable to get brief view of real time and embedded system.
CO2	Understands embedded system components and interface.
CO3	The graduates understand embedded system design and development.
CO4	The graduates Analysisof real time system performance, language and their features
CO5	The graduate will be capable to perform case study on safety, aerospace, automobile, medical and industrial application.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3				
CO1	2	3	2				
CO2	3	2	3				
CO3	2	2	1				
CO4	3	1	2				
CO5	1	2	2				

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22ET2	Course Name : EMBEDDED SYSTEMS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Microprocessor and Microcontroller	ETL	2	0/0	2/0	3

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 12

Brief overview of real time systems and embedded systems - Classification of embedded systems - Embedded system definitions - Functional and non-functional requirements - Architectures and standards - Typical applications

UNIT II EMBEDDED SYSTEM COMPONENTS AND INTERFACE 12

Device choices - Selection criteria and characteristics of Processors and memory systems for embedded applications - Interface and Peripherals - Power sources and management

UNIT III EMBEDDED SYSTEM DESIGN AND DEVELOPMENT 12

Design methods and techniques - Classification of need - Need analysis -Requirement and specification - Conceptual design - Models and languages - State machine model - State machine tables - Verification - Validation - Simulation and emulation

UNIT IV REAL TIME SYSTEMS AND MODELS 12

Characteristics and classification of real time systems - Real time specifications and Design techniques - Event based - Process based and graph-based models - Real time kernel - Hierarchy services and design strategy - Real time system performance and analysis - Typical real time systems - Their languages and features

UNIT V CASE STUDIES 12

Case studies of safety-critical - time-critical embedded systems with reference to Aerospace-automobile - Medical and Industrial applications.

Lab Components:

1. Simple assembly language program
2. Interfacing a 7-segment display
3. Serial port communication
4. GPIOs on expansion ports
5. Interfacing LCD
6. Configuring USB device port

Total No of Periods: 60

TEXT BOOKS:

1. Noergaard, T., “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier Publications, 2005
2. Berger, A.S., “Embedded System Design: An Introduction to Process, Tools and Techniques”, CMP Books, 2002

REFERENCE BOOKS:

1. David, S., “An Embedded Software Primer”, Addison-Wesley, 1999
2. Liv, J.W.S., “Real-Time Systems”, Pearson Education, 2001
3. Vahid and Givargis, T., “Embedded System Design: A Unified Hardware/ Software Introduction”, John Wiley and Sons, 2002
4. Peatman, J.B., “Design with Microcontrollers”, McGraw-Hill International Ltd.,Singapore, 1989
5. Kang, C.M.K., and Shin, G., “Real Time Systems”, McGraw Hill, 19

Course Code: EBBM22L06	Course Name: BIOPHYSICAL SIGNALS AND SYSTEMS LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To make the student demonstrate the basic concepts of bio-signals
- To impart knowledge on DFT.
- To impart knowledge on functioning of FIR- IIR filters
- To educate on characteristics of BP and its related parameters.
- To introduce the phenomenon of Cardiac related measurements.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioning of bio-signals
CO2	Ability to study of DFT
CO3	Ability to study introduction to functioning of FIR- IIR filters
CO4	Gain knowledge about the phenomenon of BP and its related parameters
CO5	Understands the concept Cardiac related measurements.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	3	2
CO3	3	2	3
CO4	2	2	3
CO5	2	2	1

H/M/L indicates Strength of Correlation H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L06	Course Name: BIOPHYSICAL SIGNALS AND SYSTEMS LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Generation of original sequence along with operation on sequence like shifting- folding- time scaling and multiplication for any Bio-signals.
2. Generation of Periodic- Exponential- Sinusoidal- Damped sinusoidal- Step- Impulse- Ramp signals using MATLAB in both discrete and analog form
3. Evaluation of convolution of Bio-signals using simulation
4. Evaluation of CFT/DFT of Bio-signals using simulation
5. Characteristics of FIR filters in processing Bio-signals
6. Characteristics of IIR filters in processing Bio-signals
7. Determination of Cross correlation and auto correlation of Bio-signals
8. Implementation of Multirate signal processing concepts.
9. Measurements of various time intervals between each segment of ECG
10. Measurement of R-R interval and calculation of Heart Rate
11. Reconstruct a signal from samples and study the effect of Aliasing.

Total No of Periods: 45

Course Code: EBBM22L07	Course Name: DIAGNOSTIC AND THERAPEUTIC LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze different bio signals
- To study about pacemaker, defibrillator and medical stimulator
- To study about different types of diathermy
- To study about ventilator
- To measure the respiratory parameter using spirometry

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Analyze different bio signals
CO2	Know about pacemaker, defibrillator and medical stimulator
CO3	Know about different types of diathermy
CO4	Know about ventilator
CO5	Measure the respiratory parameter using spirometry

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	3	2	3
CO3	1	2	1
CO4	2	3	1
CO5	2	3	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L07	Course Name: DIAGNOSTIC AND THERAPEUTIC LAB	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Analysis of ECG, EEG and EMG Signal
2. Study of Pacemaker
3. Study of Defibrillator
4. Study of medical stimulator
5. Shortwave Diathermy
6. Ultrasound Diathermy
7. Study and analysis of microwave diathermy,
8. Surgical diathermy normal and abnormal waveform, diagnosis interpretation
9. Study of ventilators
10. Measurement of Respiratory Parameters using Spirometry

Total No of Periods: 45

Course Code: EBBM22I02	Course Name :TECHNICAL SKILL II	TY /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Technical Skills1	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
								✓				

Course Code: EBBM22I02	Course Name :TECHNICAL SKILL II	TY /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Technical Skills1	IE	0	0/0	2/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Course Code: EBBM22010	Course Name: BIO SIGNAL PROCESSING	TY / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Biophysical Signals and Systems	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To give introduction to discrete time signals and systems
- To know about transformation of signals
- To know about neurological signal processing
- To acquire knowledge oncardiological signal processing
- To study ECG data reduction techniques

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Know about discrete time signals and systems
CO2	Know about transformation of signals
CO3	Know about neurological signal processing
CO4	Acquire knowledge on cardiological signal processing
CO5	Know about ECG data reduction techniques

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	3
CO2	3	2	1
CO3	2	2	1
CO4	3	2	1
CO5	2	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22010	Course Name: BIO SIGNAL PROCESSING	TY / LB/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Biophysical Signals and Systems	Ty	3	1/0	0/0	4

UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS 12

Classification and time domain representation of discrete-time signals - Typical sequences and their representation - Classification of sequences - Basic operations on sequences - Discrete-time systems

UNIT II TRANSFORM 12

Discrete Fourier Transform (DFT) computation of DFT, Z-transform - Mathematical derivation of the unilateral-properties of the Z-transform - Inverse Z-Transform

UNIT III NEUROLOGICAL SIGNAL PROCESSING 12

EEG analysis - Linear prediction theory-Autoregressive method adaptive segmentation - Transient detection - Overall performance -classification of sleep stages

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING 12

ECG data acquisition - ECG lead system ECG parameters and their estimation - Multiscale analysis for parameters estimation of ECG waveforms - Arrhythmia analysis monitoring - Continuous ECG recording

UNIT V ECG DATA REDUCTION TECHNIQUES 12

Direct ECG data compression techniques - Transformation compression techniques - Other data compression techniques - Compression clinical application of Prony's method

Total No of Periods: 60

TEXT BOOKS:

1. DC Reddy,"Biomedical signal processing", TMH, 2005

REFERENCE BOOKS:

1. Akav M., "Biomedial signal processing", Academic press 1994
2. Kok FL, "Biomedical signal processing",PHI, 1999
3. Mitra SK, "Digital signal processing", TMH, 2001

Course Code: EBBM22011	Course Name: REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To study basics of Rehabilitation Engineering
- To learn the design of Wheel Chairs
- To gain knowledge of the recent developments in the field of rehabilitation engineering.
- To understand various assistive technology for vision and hearing
- To study various orthotic and prosthetic devices

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Know the basics of Rehabilitation Engineering
CO2	Design the sustainable and environment friendly Wheel Chairs
CO3	Develop new techniques in the field of rehabilitation engineering
CO4	Analyse the assistive technology
CO5	Elaborate the Various Assistive Orthopedic Prosthetics & Application

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	1
CO3	1	1	3
CO4	2	2	3
CO5	3	3	2

H/M/L indicates Strength of Correlation H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22011	Course Name: REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I REHABILITATION TECHNOLOGY&SCIENCE 9

Selection-design or manufacturing of augmentive or assistive devices appropriate for individual with disability- Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

UNIT II REHABILITATIONADVOCACY&MEDICINE 9

Legal aspect helps the handicapped people in choosing the devices-the provisions available to them in this regard- Physiological aspects of functional recovery-neurological and physiological aspects-rehabilitation therapies training to restore vision auditory and speech

UNIT III REHABILITATION ENGINEERING 9

Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery – Universal design - Design based on human ability - Standards for assistive technology - Test for best design

UNIT IV ASSISTIVE TECHNOLOGY 9

Principles of Assistive Technology Assessment- Key Engineering Principles- Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology

UNIT V ASSISTIVE ORTHOPEDIC PROSTHETICS & APPLICATION 9

Hierarchically controlled Prosthetic Hand- Myoelectric hand and arm prosthesis – block diagram- signal flow diagram and functions- Specific Impairments and Related technologies- Future Developments – Rehabilitation Robotics- and Brain computer interface systems

Total No of Periods: 45

TEXT BOOKS:

1. Keswick.J, “What is Rehabilitation Engineering? Annual Review of rehabilitation”, volume 2 springer, New York, 1982.
2. Sunder, “Textbook of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2nd Edition, Reprint, 2007

REFERENCE BOOKS:

1. Robinsion.C.J, “Rehabilitation Engineering Handbook of electrical engineering”, CRC Press Bocaraton, 1993.

Course Code: EBCS22ID5	Course Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To give introduction to artificial intelligence
- To know about knowledge representation
- To study about knowledge organization and manipulation
- To get knowledge on acquisition and erception-communication
- To give introduction to machine learning

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Acquire basic knowledge on artificial intelligence
CO2	Know about knowledge representation
CO3	Know about knowledge organization and manipulation
CO4	Acquire knowledge on acquisition and erception-communication
CO5	Acquire basic knowledge on machine learning

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	1	3
CO2	2	3	1
CO3	3	3	1
CO4	3	2	1
CO5	2	1	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
										✓		

Course Code: EBCS22ID5	Course Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Overview of AI-general concepts-problem spaces and search - search techniques - BFS - DFS-Heuristic search techniques

UNIT II KNOWLEDGE REPRESENTATION 9

Knowledge - general concepts- predicate logic-representing simple fact- instance and ISA relationships - resolution - natural deduction

UNIT III KNOWLEDGE ORGANISATION AND MANIPULATION 9

Procedural Vs declaration knowledge - forward Vs backward reasoning - matching techniques - control knowledge/strategies - symbol reasoning under uncertainty - introduction to non – monotonic reasoning - logic for monotonic reasoning

UNIT IV KNOWLEDGE ACQUISITION AND ERCEPTION – COMMUNICATION 9

Knowledge acquisition - general concepts - learning - learning by induction - explanation based learning Natural language processing - pattern recognition - visual image understanding

UNIT V INTRODUCTION TO MACHINE LEARNING 9

Introduction- Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation- Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning- Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.

Total No of Periods: 45

TEXT BOOKS:

1. Elaine Rich and Kelvin Knight, “Artificial Intelligence”, Tata McGraw-Hill, New Delhi, 1991
2. Stuart Russell and Peter Norvig, “Artificial Intelligence: A modern approach”, Prentice Hal, 1995
3. Tom M. Mitchell, ―Machine Learning‖, McGraw-Hill Education (India) Private Limited, 2013.

REFERENCE BOOKS:

1. Nelson N.J.,“Principles of Artificial Intelligence”, Springer Verlag, Berlin, 1980
2. Patterson, “Introduction to Artificial Intelligence and Expert systems”, Prentice Hall of India, New delhi, 1990.
3. EthemAlpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.

Course Code: EBBM22ET3	Course Name: COMMUNICATION SYSTEMS FOR MEDICAL APPLICATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze analog communication techniques.
- To describe data and pulse communication systems.
- To demonstrate various digital communication techniques.
- To describe optical communication.
- To utilize multi-user radio communication.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyse analog communication techniques.
CO2	Describe data and pulse communication systems.
CO3	Demonstrate various digital communication techniques
CO4	Describe optical communication.
CO5	Utilize multi-user radio communication.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	2	2	3
CO3	2	2	1
CO4	3	2	1
CO5	2	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22ET3	Course Name: COMMUNICATION SYSTEMS FOR MEDICAL APPLICATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

UNIT I ANALOG COMMUNICATION 12

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems

UNIT II DATA AND PULSE COMMUNICATION 12

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse Code Modulation (PCM) – Comparison of various Pulse Communication System .

Data Communication: History of Data Communication – Standards, Organizations for Data Communication- Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces.

UNIT III DIGITAL MODULATION 12

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System.

UNIT IV OPTICAL COMMUNICATION 12

Introduction-general optical fiber communication system- basic optical laws and definitions-optical modes and configurations - fiber optic cables-classification of optical fiber-single mode fiber-graded index fiber. Attenuation-absorption --scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference – Sources : LED and LASER – Detectors : Photo detector-Avalanche photo diodes

UNIT V MULTI-USER RADIO COMMUNICATION 12

Global System for Mobile Communications (GSM) – Code Division Multiple Access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Handover Techniques – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

Lab Components

1. Generation and detection of AM and FM
2. PAM
3. PWM
4. PCM
5. ASK
6. FSK/PSK.

Total No of Periods: 60

TEXT BOOKS:

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, PearsonEducation, 2009.
2. B.P.Lathi,“ModernAnalog and Digital Communication Systems”, 3rdEdition, Oxford University Press,2007.

REFERENCE BOOKS:

1. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition,Pearson Education,2007
3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition,Pearson Education, 2007.

Course Code: EBBM22L08	Course Name: BIO SIGNAL PROCESSING LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To acquire different bio signals.
- To analyze the different bio signals in time domain
- To analyze the bio signals in frequency domain.
- Detection of R peak and R-R interval from acquired ECG signal
- To compare the bio signals using different filters

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Acquire different bio signals.
CO2	Analyze the different bio signals in time domain
CO3	Analyze the bio signals in frequency domain.
CO4	Detect of R peak and R-R interval from acquired ECG signal
CO5	To compare the bio signals using different filters

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	1	1	1
CO3	2	2	3
CO4	3	3	2
CO5	2	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L08	Course Name: BIO SIGNAL PROCESSING LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. To acquire and analyze ECG signal
2. Design a HPF of defined cut-off frequency to remove low frequency noises in acquired ECG Signal.
3. Detection of R peak and R-R interval from acquired ECG signal
4. Compare different types of FIR filter for LPF of ECG signal
5. Compare different types of IIR filter for LPF of ECG signal
6. Spectral analysis of ECG signal
7. To acquire and analyze EEG signal
8. Spectral analysis of EEG signal
9. To acquire and analyze EMG signal
10. To acquire and analyze EOG signal

Total No of Periods: 45

Course Code: EBBM22I03	Course Name : TECHNICAL SKILLS III	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: TECHNICAL SKILLS II	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Intredisciplinary		
								✓				

Course Code: EBBM22I03	Course Name : TECHNICAL SKILLS III	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: TECHNICAL SKILLS II	IE	0	0/0	2/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Course Code: EBBM22I04	Course Name :MINI PROJECT/ INTERNSHIP	TY /LB/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the Inplant training is to provide a short-term work experience in an Industry/ Company/ Organization

COURSE OUTCOMES (COs) : (3- 5)

CO1	To get an insight of an industry / organization/company pertaining to the domain of study
CO2	To acquire skills and knowledge for a smooth transition into the career.
CO3	To gain field experience and get linked with the professional network

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	3	3	3	3	3	3	3
CO2	3	2	3	2	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	3	3	2

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22I04	Course Name :MINI PROJECT/ INTERNSHIP	TY /LB/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0	3/0	1

MINI PROJECT

Students will have an opportunity to expose their knowledge and talent to make an innovative project. Students are supposed to do innovative projects useful to industries/society in the area of relevant Engineering, inter and multi-disciplinary areas, under the guidance of a staff member. They have to prepare a project report and submit to the department.

At the end of the semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

INTERNSHIP

Students are supposed to undergo internship in related Industries for a minimum period of 30days cumulatively during the semester. They have to prepare a report on the Internship with a certificate in proof from competent authority in the industry. At the end of the semester Viva-Voce examination will be conducted by the Examiners duly appointed by the Head of the department and the students will be evaluated.

Course Code: EBCC22I07	Course Name : SOFT SKILLS II - QUALITATIVE AND QUANTITATIVE SKILLS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Soft Skills - I	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To help students to improve their Logical reasoning.
- To help students to improve their arithmetic reasoning.
- To help students improve their data interpretation skills

COURSE OUTCOMES (COs) : (3- 5)

CO1	Prepare students for Logical reasoning
CO2	Prepare students for arithmetic reasoning
CO3	Prepare students for data interpretation skills

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	2	3	2	3	2	3
CO2	1	1	1	1	1	2	2	3	2	3	2	3
CO3	1	1	1	1	1	2	2	3	2	3	2	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	3
CO2	1	1	3
CO3	1	1	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
									✓			

Course Code: EBCC22I07	Course Name : SOFT SKILLS II - QUALITATIVE AND QUANTITATIVE SKILLS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Soft Skills - I	IE	0	0/0	2/0	1

UNIT I LOGICAL REASONING I **6**

Logical Statements – Arguments – Assumptions – Courses of Action

UNIT II LOGICAL REASONING II **6**

Logical conclusions – Deriving conclusions from passages – Theme detection

UNIT III ARITHMETICAL REASONING I **6**

Number system – H.C.F and L.C.M – Problem on ages – Percentage – Profit and Loss – Ratio and Proportion – Partnership

UNIT IV ARITHMETICAL REASONING II **6**

Time and Work – Time and Distance – Clocks – Permutations and Combinations – Heights and Distances – Odd man out and Series

UNIT V DATA INTERPRETATION **6**

Tabulation – Bar graphs – Pie graphs – Line graphs

Total No of Periods: 30

REFERENCE BOOKS:

1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand and Co., (2017).
2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand and Co., (2017).
3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand and Co., (2017).
4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).
5. B.S.Sijwali, Indusijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).

Course Code: EBBM22012	Course Name :MEDICAL IMAGING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the fundamental of medical image
- To understand the concept of preprocessing of image
- To learn the analysis and classification of medical images
- To analyze the reconstruction of CT and MRI images
- To learn concept of transmission of medical images

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the fundamental of medical image
CO2	Capable to understand the concept of preprocessing of image
CO3	Capable to analyze and classify the medical images
CO4	Can analyze the reconstruction of CT and MRI images
CO5	Capable to summarize the concept of transmission of medical images

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	1	2	3
CO3	3	2	1
CO4	1	1	1
CO5	2	3	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22012	Course Name :MEDICAL IMAGING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I IMAGE FUNDAMENTALS 9

Image perception- MTF of the visual system- image fidelity criteria- image model- image sampling and quantization - sampling theory- image quantization- optimum mean square quantizer- image transforms - 2D-DFT and other transforms- Relationships between pixels

UNIT II IMAGE PREPROCESSING 9

Image enhancement - point operation- spatial operations- Smoothing and Sharpening -Spatial Filtering- transforms operations- Image restoration- Smoothing and Sharpening frequency domain filters - image degradation model- inverse and Wiener filtering

UNIT III IMAGE ANALYSIS AND CLASSIFICATION 9

Image analysis - spatial feature extraction- edge detection- image segmentation classification techniques - statistical methods- neural network approaches- Region based segmentation- Morphological processing- erosion and dilation

UNIT IV RECONSTRUCTION OF CT AND MRI IMAGES 9

Image reconstruction from projections - Radon transforms- filter back projection algorithm- algebraic methods- 3D tomography- imaging methods in CT images- imaging methods in magnetic resonance imagers

UNIT V TRANSMISSION OF MEDICAL IMAGES 9

Medical image data compression and transmission - transform coding pixel coding- predictive coding- interframe coding - Application of image processing techniques in thermography –SPECT -PET- AI techniques in medical imaging -Bio magnetic diagnosis in connection with medical imaging of CT or MRI- image processing algorithms on medical images

Total No of Periods: 45

TEXT BOOKS:

1. Albert Macouskl, “Medical Imaging Systems”, Prentice Hall New Jersery, 1983
2. Gonzalez. R and Wintz P., “Digital Image Processing”,Addision Wesley Publishing Co. USA, 1987

REFERENCE BOOKS:

1. Eric Krestel, “Imaging Systems for Medical diagnosis”, Siemens Aktlengesellschaft, FRG, 1995
2. Alfred Horowitz,“MRI Physics for Radiologists – A Visual Approach”, Springer Verlag, New York, II Edition, 1991
3. Anil K. Jain, “Fundamental of Digital Image Processing”, Prentice Hall of India Pvt Ltd., New Delhi, 1995

Course Code: EBBM22013	Course Name: TELEMEDICINE TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the key principles for Telemedicine and health
- To understand ethical, security and legal aspects of Telemedicine
- To understand Telemedical technology.
- To get knowledge on Data acquisition and storage system
- To know the application of Telemedicine

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Analyze the principle for Telemedicine
CO2	Understand the ethical, security and legal aspects of Telemedicine
CO3	Ability use the technology for Telemedicine
CO4	Get knowledge on Data acquisition and storage system
CO5	Understands and apply the Telemedicine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	3	2
CO3	3	1	3
CO4	3	1	3
CO5	2	1	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22013	Course Name: TELEMEDICINE TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO TELEMEDICINE 9

History and Evolution of telemedicine - Functional diagram of telemedicine system - Essential Parameters for Telemedicine - Delivery Modes in Telemedicine - Benefits and Limitations of Telemedicine.

UNIT II ETHICAL, SECURITY 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 - Security in Telemedicine systems – Access control - Fire wall – Encryption –Authentication - Digital certificate - Digital Timestamp.

UNIT III TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia – Text – Audio – Video – data – PSTN – POTS – ANT – ISDN – Internet - Wireless Communication - GSM satellite - and Micro wave - Modulation techniques - Types of Antenna - Satellite communication - Mobile hand-held devices and mobile communication - Internet technology and telemedicine using worldwide - Video and audio conferencing.

UNIT IV DATA ACQUISITION AND STORAGE SYSTEM 9

Acquisition System – Camera, Scanners, Display Systems – Analogue Devices – LCD - Laser Displays -Holographic Representation - Virtual Screen devices - Storage System – Magnetic System - Optical System - Solid State Disk.

UNIT V APPLICATIONS OF TELEMEDICINE 9

Telemedicine access to health care services – health education and self-care -· Introduction to robotics surgery – Telesurgery – Teleradiology – Telepathology – Teleoncology - Telepathology

Total No of Periods: 45

TEXT BOOKS:

1. Olga Ferrer Roca, M.SosaIudicissa , “Hand book of Telemedicine”, IOS press, 2002.
2. Norris.A.C, “Essentials of Telemedicine and Telecare”, John Sons & Ltd, 2002

REFERENCE 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.

Course Code: EBBM22014	Course Name: MEDICAL WASTE MANAGEMENT	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To know about bio waste and segregation and disposal
- To categorize the biomedical waste
- To get knowledge on hospital generated waste
- To know about different types of waste disposal
- To study about bioethics and recent trends

COURSE OUTCOMES (COs) : (3- 5)Students will be able to

CO1	Get knowledge on bio waste and segregation and disposal
CO2	Categorize the biomedical waste
CO3	Get knowledge on hospital generated waste
CO4	Know about different types of waste disposal
CO5	Know about bioethics and recent trends

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	3	2	1
CO3	2	3	2
CO4	3	2	1
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22014	Course Name: MEDICAL WASTE MANAGEMENT	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION AND WASTE SEGREGATION 9

General Introduction- Definition of Biomedical Waste- General and Hazardous health care waste - Colour Coding and types of containers for disposal of medical waste – Segregation - Collection and Disposal

UNIT II TYPES OF BIOMEDICAL WASTE 9

Infectious waste - Genotoxic waste - Waste Sharps – Categories - Categorization and composition of Biomedical waste - Liquid Biomedical Waste - Radioactive wastes – Metals - Chemicals & drugs

UNIT III HOSPITAL GENERATED WASTE 9

Human Blood and Blood Products-Contaminated sharps- Contaminated animal carcasses- body partsand bedding -Basic information about infection- Infectious agents on organizations spread of infection- Basic information about Hospital acquired infection

UNIT IV TYPES OF WASTE DISPOSAL 9

Disinfections unit container for Autoclaving- Sharp waste containers for storage and transportation - autoclaving - Incineration- Plasma Pyrolysis /Gasification systems- Composting

UNIT V BIOETHICS AND RECENT TRENDS 9

Modern Technology for handling Biomedical Wastes - Monitoring and Controlling of Cross Infections- Protective Devices - Bioethics and Handling of Waste Management.

Total No of Periods:45

TEXT BOOKS:

1. V. J. Landrum, “Waste Management and disposal”, Elsevier, ISBN: 978-0-8155-1264-6, 1991
2. S A Tabish, “Principles of Hospital Management”, OUP, Jaypee Publishers.6thEdition, 2000
3. S L Goel, Dr. R. Kumar, “Encyclopedia of Hospital Management - Text and Case Studies Hospitals in Community Health Care”, ISBN (Hardbound): 8184502273, 9788184502275, 2010

REFERENCE BOOKS:

1. J. Glyn Hendry & Gary W Heinke, “Environmental Science and Engineering”, Prentice Hall India, 2004
2. Shyam Divan, “Environmental law and policy in India”, Oxford India Press, 2004
3. Charles A Wentz, “Hazardous Waste Management”, McGraw Hill Inc, New York, 1995

Course Code: EBBM22015	Course Name: BIOMEDICAL OPTICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- Understand the characteristics of tissue when it is exposed to light
- Learn about the Instrumentation in photonics
- Know about various optical sources and applications of lasers in medicine
- Know about non thermal diagnostic application
- Know about therapeutic application

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Recall the optical properties
CO2	Illustrate the concept of biomedical optics in various real life applications
CO3	Analyze the instrumentation involved in biomedical optics
CO4	Apply laser instrumentation in medical diagnosis and therapy
CO5	Discuss the therapeutic applications in the field of medicine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	3
CO3	2	2	2
CO4	3	2	2
CO5	2	1	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22015	Course Name: BIOMEDICAL OPTICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Optical properties of the tissues – Refraction – Scattering – Absorption -Light transport inside the tissue - Tissue properties -Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical Thermal- Electromechanical – Photoabalative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation in photonics: 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.

UNIT III LASER APPLICATIONS 9

Laser applications: Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology - Tissue welding-Imaging System Fundamentals - Endoscopic imaging system fundamentals – Angioscope – Videoscopy - Fluorescence endoscopy - Flourescent probes in biomedical applications

UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS 9

Non thermal diagnostic applications - 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

Therapeutic applications – Phototherapy - Photodynamic therapy (PDT) - Principle and mechanism - Oncological and nononcological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures

Total No of Periods: 45

TEXT BOOKS:

1. Tuan Vo Dinh, Biomedical Photonics Handbook, CRC Press, Newyork, 2003
2. Lasers and Current Optical Techniques in Biology, Royal Society of Chemistry, 2004.

REFERENCE BOOKS:

1. MarkolfH.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007
2. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic press Inc.
3. Maini, Anil. Lasers and Optoelectronics: Fundamentals, Devices and Applications, John Wiley & Sons, Incorporated, 2013.
4. Elias Greenbaum, Radiation physics for medical physicists (Biological and Medical physics, biomedical engineering) Springer, 2014
5. Mark Csele: Fundamentals of Light source and Lasers” Wiley Inderscience Publishers 2004.

Course Code: EBBM22ET4	Course Name: MEDICAL INSTRUMENTS AND SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To know about patient safety and monitoring
- To study heart-lung machine
- To study hemodialysis
- To know about ultrasonic techniques
- To acquire knowledge on sensory measurement and anesthesia machine

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Get knowledge on patient safety and monitoring
CO2	Acquire knowledge on heart-lung machine
CO3	Acquire knowledge hemodialysis
CO4	Know about ultrasonic techniques
CO5	Acquire knowledge on sensory measurement and anesthesia machine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	1
CO3	2	3	1
CO4	2	3	1
CO5	1	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22ET4	Course Name: MEDICAL INSTRUMENTS AND SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	2	0/0	2/0	3

UNIT I PATIENT SAFETY AND PATIENT MONITORING 12

Physiological effects of electricity - important susceptibility parameters - Sources of leakage current - Micro and Macro shock-monitoring circuits-earthing schemes- Electrical safety analyzer - Testing the Electric system - Patient monitoring system – ICU -post operative, ICCU

UNIT II HEART-LUNG MACHINE 12

Need for the unit -functioning of bubble -disc type and membrane type oxygenators -finger pump -roller pump -electronic monitoring of functional parameter- Heart rate monitor - Holter Monitor – Phonocardiography - Plethysmography

UNIT III HAEMODIALYSIS 12

Haemodialysis Machines - Function of the kidneys - Artificial Kidney - Dialyzers - Membrances of haemodialyzers - Haemodialysis machines - Portable Kidney machines. Lithotripters - The stone disease problem - First lithotripter machine - modern lithotripter systems - Extracorporeal Shockwave Therapy.

UNIT IV ULTRASONIC EQUIPMENTS 12

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

UNIT V SENSORY MEASUREMENT AND ANESTHESIA MACHINE 12

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Audiometer, Eye Tonometer, Apnea detectors - Oximetry - Pulse oximeter - Ear oximeter. Anesthesia Machine - Need for Anesthesia - Anesthesia machine - Electronics in Anesthesia machine.

Lab Components

1. Patient Monitoring System
2. Heart Lung Machine
3. Hemodylizer
4. Ultrasound scanner
5. Human auditory response using an Audiometer
6. Pulse oximeter

Total No of Periods: 60

TEXT BOOKS:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 1997
2. Joseph J.carr and John M. Brown, “Introduction to Biomedical equipment technology”, John wiley and sons, New York, 1997
3. Cromwell, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, New Delhi, 2007

REFERENCE BOOKS:

1. John G. Webster, Biomedical Instrumentation, Wiley Publications.2007.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 1998

Course Code: EBBM22L09	Course Name: BIO IMAGE PROCESSING LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: MEDICAL IMAGE TECHNIQUES	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To practice image sampling, quantization and analysis
- To practice basic transformation
- To practice the basic image processing techniques.
- To understand the concepts of image restoration and segmentation.
- To explore the applications of image processing techniques.

COURSE OUTCOMES (COs): (3- 5)Students will be able to

CO1	Sample, quantization and analyze the image
CO2	Perform basic transformation
CO3	Practice the basic image processing techniques.
CO4	Understand the concepts of image restoration and segmentation.
CO5	Explore the applications of image processing techniques.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	3
CO2	3	1	2
CO3	2	3	2
CO4	1	2	2
CO5	1	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L09	Course Name: BIO IMAGE PROCESSING LAB	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: MEDICAL IMAGE TECHNIQUES	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS (Simulate using any simulation Software)

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. Transforms (DFT, DCT, Walsh, Hadamard, Haar)
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Image restoration – Inverse and wiener filtering
11. Basic Morphological operations.
12. Analysis of images with different colour models**.**

Total No of Periods: 45

Course Code: EBBM22I05	Course Name :PROJECT PHASE - I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**IE**	**0**	**0/0**	**3/3**	**2**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue,address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	1	2	2	3	3
CO2	3	3	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	2
CO4	3	2	3	3	3	3	2	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22I05	Course Name :PROJECT PHASE - I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0/0	3/3	2

Students are expected to do the Project in a group of 3 to 4 students. They should identify the area/topic of the Project and should collect the literatures related to the project. Students intending to do Industrial projects will approach the industries with the support of the university, identify the industrial problem and finalize the project. In case of Industrial projects apart from Industry guide, a guide has to be appointed by the department. At the end of the Semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted by the examiners duly appointed by the Head of the department.

Course Code: EBFL22IXX	Course Name: FOREIGN LANGUAGE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To recognize the cultural values, practices, and heritage of the foreign country, communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Achieve functional proficiency in listening, speaking, reading, and writing.
CO2	Develop an insight into the nature of language itself, the process of language and culture acquisition.
CO3	Decode, analyze, and interpret authentic texts of different genres.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	3	1	3	2	3	3	1
CO2	2	1	1	1	1	3	1	3	3	3	3	1
CO3	1	1	2	2	1	3	2	3	2	3	3	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
			✓									

Course Code: EBFL22IXX	Course Name: FOREIGN LANGUAGE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	IE	0	0/0	3/0	1

Foreign language is introduced in the curriculum to make the students globally employable. Students should select and register for any one of the foreign languages from the given list. At the end of the course students should be able to read, write and converse the language in the basic level. At the end of the semester the assessment will be done through internal examination by the examiner duly appointed by the head of the department.

S.NO	COURSE CODE	COURSE NAME
1	EBFL22I01/HBFL22I01	FRENCH
2	EBFL22I02/ HBFL22I02	GERMAN
3	EBFL22I03/ HBFL22I03	JAPANESH
4	EBFL22I04/ HBFL22I04	ARABIC
5	EBFL22I05/ HBFL22I05	CHINESE
6	EBFL22I06/HBFL22I06	RUSSIAN
7	EBFL22I07/HBFL22I07	SPANISH

Course Code: EBCC22ID4	Course Name: MEDICAL INNOVATION AND ENTREPRENEURSHIP	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To know the nature of innovation and entrepreneurship in healthcare
- To know about developing innovation and entrepreneurship in healthcare
- To study about leading innovation and entrepreneurship in healthcare
- To develop future oriented mindset
- To know about financing and marketing

COURSE OUTCOMES (COs): (3- 5)Students will be able to

CO1	Know the nature of innovation and entrepreneurship in healthcare
CO2	Know about developing innovation and entrepreneurship in healthcare
CO3	Know about leading innovation and entrepreneurship in healthcare
CO4	Develop future oriented mindset
CO5	Know about financing and marketing

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	1	2	3
CO3	3	2	3
CO4	2	1	1
CO5	3	2	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
			✓									

Course Code: EBCC22ID4	Course Name: MEDICAL INNOVATION AND ENTREPRENEURSHIP	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I MEANING AND NATURE OF INNOVATION AND ENTREPRENEURSHIP IN HEALTHCARE 9

Understanding creativity, Creative Techniques, innovation, Creativity and Innovation In Healthcare, Barriers to Creativity and Innovation in Healthcare. Entrepreneurship - Linking Creativity, Innovation and Entrepreneurship

UNIT II DEVELOPING INNOVATION AND ENTREPRENEURSHIP IN HEALTHCARE: A STRATEGIC PERSPECTIVE **9**

Developing innovation in healthcare - Strategic perspective: integration of innovation and entrepreneurship in healthcare - Corporate entrepreneurship, well-being, resilience and positive psychology in healthcare

UNIT III LEADING INNOVATION, ENTREPRENEURSHIP AND DESIGN THINKING IN HEALTHCARE 9

Leadership and its impact on innovation and entrepreneurship in healthcare - Innovation and entrepreneurship among individuals and teams in healthcare - Understanding and leading design thinking in healthcare

UNIT IV MAKING IT ALL HAPPEN: A FUTURE-ORIENTED MINDSET **9**

Women in leadership, innovation and entrepreneurship in healthcare - Human capital and the future impact of innovation and entrepreneurship on key stakeholders - The future of innovation and entrepreneurship in healthcare References Index

UNIT V FINANCING & MARKETING **9**

Determining financial needs - sources of financing - equity and debt funding. Marketing function: Industry analysis - competitor analysis - marketing research for the new venture - defining the purpose or objectives - gathering data from secondary sources - gathering information from primary sources - analyzing and interpreting the results - the marketing process, ethics and business decisions.

Total No of Periods: 45

TEXT BOOKS:

1. Claudine Kearney, “Leading Innovation and Entrepreneurship in Healthcare”, Edward Elgar Publishing 2022
2. Robert D Hisrich, Michael P Peters & Dean Shepherd, “Entrepreneurship”, Tata McGrawHill, 2007.
3. Donald F.Kuratko and Richard M.Hodgetts, “Entrepreneurship”, SouthWestern/Cengage Learning, 2008.

REFERENCE BOOKS:

1. Ralf Wilden, Massimo Garbuio, Federica Angeli, Daniele Mascia,"Entrepreneurship in Healthcare", Routledge 2020.
2. Thomas W.Zimmerer, Norman M.Scarborough, Essentials of Entrepreneurship and Small Business Management, Prentice Hall of India, 2009.
3. Marc J Dollinger, Entrepreneurship - Strategies and Resources, Pearson Education, 2003.
4. Mary Coulter, Entrepreneurship in Action, Prentice Hall of India, New Delhi, 2006

Course Code: EBBM22L10	Course Name : PROJECT PHASE - II	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	12/12	8

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue,address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
							✓					

Course Code: EBBM22L10	Course Name : PROJECT PHASE - II	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Lb	0	0/0	12/12	8

To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

Students are expected to do a Project work either in an Industry or at the University in the field of relevant Engineering /inter-disciplinary /multi-disciplinary area in a group of 3 or 4 students. The work to be carried out in Phase II should be continuation of Phase I. Each group will be allotted a guide based on the area of Project work. In case of industrial Project external guide has to be allotted from Industry. Inter disciplinary/multi-disciplinary project can be done with students of different disciplines as a group. Monthly reviews will be conducted during the semester to monitor the progress ofthe project by the project review committee. Students have to submit the Project thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by the examiners duly appointed by the Controller of Examination. In case of industrial project certificate in proof has to be included in the report along with the bonofide certificate.

PROGRAM ELECTIVE - I

Course Code: EBBM22E01	Course Name : BIOMETRIC SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn about the biometric systems
- To study about image processing fundamentals in biometrics.
- To inculcate knowledge on personal privacy and security implications of Biometrics based identification.
- To learn about biometric interfaces
- To study about Biometric applications in the field of medicine

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Understand the basic concepts of fingerprint, iris, face and speech recognition
CO2	Studies the general principles of design of biometric systems and the underlying trade-offs
CO3	Gains knowledge on personal privacy and security implications of biometrics based identification
CO4	Acquires knowledge about physiological and behavioral biometrics characteristics
CO5	Understands the Biometric applications in the field of medicine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	3	2	3
CO3	1	2	1
CO4	2	3	1
CO5	2	3	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E01	Course Name : BIOMETRIC SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT 1 BIOMETRIC FUNDAMENTALS 9

Biometrics versus traditional techniques – Characteristics - Key biometric processes -Verification – Image processing/pattern recognition- filtering- edge detection- smoothening- enhancement- Biometric matching - Performance measures in biometric systems - Assessing the privacy risks of biometrics.

UNIT 2 IMAGE PROCESSING FUNDAMENTALS 9

Convolution- linear/non-linear filtering- Special filters- enhancement filter- edge detection- Laplacian- unsharp masking- high boot filtering- sharpening special filtering- thresholding- localization- Robert's method- Sobal's method- Canny edge detection- Positive/negative identification- Biometric system security- Authentication protocols- Authentication methods.

UNIT 3 PHYSIOLOGICAL AND BEHAVIORAL BIOMETRICS CHARACTERISTICS 9

Facial scan - Ear scan, Retina scan -Iris scan - Finger scan - automated fingerprint identification system - Palm print - Hand vascular geometry analysis - DNA - Dental. Signature scan - Keystroke scan - Voice scan, Gait recognition - Gesture recognition - Video face - mapping the body technology.

UNIT 4 BIOMETRIC INTERFACES 9

Human machine interface - BHMI structure, Human side interface: Iris image interface - Hand geometry and fingerprint sensor - Machine side interface - Parallel port - Serial port - Network topologies.

UNIT 5 BIOMETRIC APPLICATIONS 9

Categorizing biometric applications, Application areas: Criminal and citizen identification – Surveillance - PC/network access - E-commerce and retail/ATM - Costs to deploy - Issues in deployment - Biometrics in medicine - cancellable biometrics.

Total No of Periods: 45

Text Books:

1. Ruud M. Bolle et al, “Guide to Biometrics”, Springer, USA, 2003.
2. Richard O Duda, David G. Strok, Peter E hart, “Pattern Classification”, Wiley 2007
3. Rafael C. Gonzalez, Richard Eugene Woods, “Digital Image Processing using MATLAB”, Mc-Graw Hill 2010

Reference Books:

1. Anil K. Jain, Arun Ross, and Karthik Nandakumar, “Introduction to biometrcis”, 2011
2. James Wayman, Anil Jain, DavideMaltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, 2005
3. S.Y. Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach” Prentice Hall, 2005
4. Nalini K Ratha, Ruud Bolle, “Automatic fingerprint Recognition System”, Springer, 2003
5. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition” CRC Press, 1999.
6. David D Zhang, “Automated Biometrics: Technologies and Systems”, Kluwer Academic Publishers, New Delhi, 2005

Course Code: EBBM22E02	Course Name :BIO MEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMATERIALS	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the working principle of MEMS and Microsystems
- To understand the working of MOEMS Technology
- To understand the concepts of Bio MEMS and its application in healthcare
- To give an insight to the DNA based Bio MEMS
- To study about the biomedical Nanotechnology and its application in research domain

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Understands the working principle of MEMS and Microsystems
CO2	Understands the working of MOEMS Technology
CO3	Understands the concepts of Bio MEMS and its application in healthcare
CO4	Acquires knowledge on the DNA based Bio MEMS
CO5	Acquires knowledge on the biomedical Nanotechnology and its application in research domain

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	2	3	1
CO3	3	3	3
CO4	2	3	1
CO5	1	2	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E02	Course Name :BIO MEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMATERIALS	Ty	3	0/0	0/0	3

UNIT I MEMS 9

Introduction - Typical MEMS Products - Application of Micro-system in Healthcare Industry - Working Principles of Microsystems Microsensors -Microactuation - MEMS with actuation - Micro-accelerators and Microfluidics - Materials for MEMS and Microsystems

UNIT II MEMS and Microfluidics 9

Fundamental principle - Light Modulators -Beam splitter - Micro-lens -Micro-mirrors - Digital Micro-mirror Device -Light detectors - Important Consideration on Micro-scale fluid -Properties of fluid - Fluid Actuation Methods - Micro-pumps - Typical Micro-fluidic Channel -Micro-fluid Dispenser

UNIT III BIOMEMS 9

Introduction -Principle of Biosensor -Ampero-metric Biosensor - Micro-dialysis - BioMEMS for Clinical Monitoring - Monitoring of Glucose and Lactate with a micro-dialysis probe - Ammonia Monitoring - Electronic Nose -DNA Sensors

UNIT IV BIOMEMSAND DNA 9

Unique features of Nucleic Acids -Lab on the Chip –Electrophoresis -Polymerase Chain Reaction (PCR) -Biochemical reaction chains for integration: Biosensors and the "lab biochip" - Typical Microarray experiment -Manufacturing of Microarrays -Synthesis on the chip -Spotting Techniques - PCR on the chip -Microchamber Chips -Micro-fluidics Chips -Emerging BioMEMS Technology

UNIT V BIOMEDICAL NANOTECHNOLOGY 9

Nanoparticles- Nanomaterial characterization – XRD –SAXS –TEM –SEM -Scanning Tunneling microscopy –AFM -SPM technique -Biomolecular sensing for cancer diagnostics using carbon nanotubes -Carbon nanotube biosensors -Magnetic nanoparticles for MR Imaging -Nano-devices in biomedical applications

Total No of Periods: 45

TEXT BOOKS:

1. Steven S, Saliterman, "Fundamentals of BioMEMS and Medical Microdevices", International Society for Optical Engineering, First Edition 2006
2. NitaigourPremchandMahalik, "MEMS", Tata McGraw Hill, 2nd Reprint, 2008
3. Wanjun Wang and Steven A.Soper, "BioMEMS- Technologies andapplications", CRC Press, First edition, 2007

REFERENCE BOOKS:

1. Tai-Ran Hsu, "MEMS and Microsystems- Design, Manufacture and NanoscaleEngineering", John Wiley and Sons, 2nd Edition, 2008
2. Gerald A Urban, "BioMEMS", Springer, First Edition, 2006
3. Abraham P. Lee and James L. Lee, "BioMEMS and BiomedicalNanotechnology", Volume I, Springer, First Edition, 2006
4. Paul C.H. Li, "Introduction to Microfluids and BioMEMS: A Design andProblem-Solving Textbook", CRC Press, First Edition, 2009
5. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, First Edition 2002.

Course Code: EBBM22E03	Course Name :NEURAL NETWORKS AND FUZZY LOGIC CONTROL	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To acquire knowledge in Fuzzy sets
- To learn optimization analysis
- To learn about soft computing techniques Neutral network
- To learn about fuzzy interface.
- To implement the soft computing techniques in biomedical engineering

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Ability to analysis the fuzzy sets.
CO2	Gain knowledge about optimization analysis.
CO3	Understand neutral network.
CO4	Gain knowledge in interface systems.
CO5	Apply the soft techniques in application of bio medial engineering.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3	2	2	3	2	3	2	3
CO2	3	2	2	2	2	3	3	2	3	2	3	2
CO3	2	3	3	3	3	2	2	3	2	3	2	3
CO4	2	2	2	2	2	3	2	2	3	2	3	2
CO5	2	3	3	3	3	2	3	3	2	3	2	2

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	2
CO3	2	2	3
CO4	2	2	2
CO5	3	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
				✓								

Course Code: EBBM22E03	Course Name :NEURAL NETWORKS AND FUZZY LOGIC CONTROL	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I BASIC NEURAL NETWORK TECHNIQUES 9

Back propagation neural net: standard back propagation-architecture algorithm- derivation of learning rules number of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine

UNIT II COMPETITIVE NEURAL NETWORKS 9

Neural network based on competition: fixed weight competitive nets- Kohonen self organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2

UNIT III SPECIAL NEURAL NETWORKS 9

Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems. Supervised Learning Neural Networks – Perceptron's - Adaline – Back propagation Multilayer Perceptron's – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – KohonenSelf Organizing Networks – Learning Vector Quantization – Hebbian Learning

UNIT IV FUNDAMENTALS OF FUZZY LOGIC 9

Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Input Space Partitioning and Fuzzy Modeling

UNIT V FUZZY INTERFACE SYSTEMS 9

Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation

TEXT BOOKS:

1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.
3. S.Rajasekaran and G.A.V.Pai, "Neural Networks- Fuzzy Logic and Genetic Algorithms", PHI-2003.

REFERENCE BOOKS:

1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.

Course Code: EBBM22E04	Course Name: BIOFLUID AND DYNAMICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Biomechanics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Know the basics of fluid mechanics
- To construe the intracellular and ocular mechanics
- To describe the rheology of blood and mechanics of blood vessels
- To elucidate on cardio respiratory mechanics and space medicine
- To develop mathematical models of biological systems with fluids

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Know the basics of fluid mechanics
CO2	Construe the intracellular and ocular mechanics
CO3	Describe the rheology of blood and mechanics of blood vessels
CO4	Elucidate on cardio respiratory mechanics and space medicine
CO5	Develop mathematical models of biological systems with fluids

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	3	1
CO3	3	2	1
CO4	1	2	3
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E04	Course Name: BIOFLUID AND DYNAMICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Biomechanics	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I BIOFLUID MECHANICS 9

Intrinsic fluid properties - Density, viscosity, Compressibility, Surface tension, Hydrostatics Fluid characteristics and viscosity – Displacement and velocity, Sheer stress and viscosity Bernoulli equation. Introduction to pipe flow – Reynolds number, Poiseuille‘s law, Flow Rate, Womersley number, Constitutive equations – Newtonian fluid, Non-Newtonian viscous fluid, Diameter, velocity and pressure of blood flow relationship, Resistance against flow, Visco elasticity –Visco elastic models, Response to Harmonic variation, Use of visco elastic models, Bio-Visco elastic fluids – Protoplasm, Mucus, Saliva, Synovial fluids.

UNIT II CELLULAR AND OCCULAR MECHANICS 9

Cellular Biomechanics – Eukaryotic cell architecture, Cytoskeleton, Cell-matrix interactions, Mechanical property measurement – Atomic Force microscopy, Optical Trapping, Magnetic bead micro rheometry, Micropipette aspiration, Models of cellular biomechanical behavior, Computational model of a chondrocyte in its matrix, Mechano transduction, Techniques for mechanical stimulation of the cells, Tissue cell mechano biology – Endothelial, smooth muscle cells, Chondrocytes, Osteoblasts, Ocular Biomechanics – Occular anatomy, Biomechanics of Glaucoma, Ocular blood flow.

UNIT III BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS 9

Viscometry, Elements of Blood, Blood characteristics – Viscosity of blood, Einstein‘s equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation,Casso’s equation, Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion, Anatomy and physiology of blood vessels, Arterial wall as membrane – Uniaxial loading, Biaxial loading, Torsion, Hemodynamics of Large arteries – Ventricular outflow and theaorta, Pressure-flow relations and Vascular Impedance, Wave propagation and reflection.

UNIT IV CARDIORESPIRATORY MECHANICS AND SPACE MEDICINE 9

Cardiac cycle – Pressure volume diagrams, Changes in contractility, Ventricular performance, Congestive heart failure, Pulsatility index, Physics of valvular diseases, Prosthetic heart valves andreplacements, Respiratory System – Alveolar ventilation-lung volumes and capacities, Mechanicsof breathing, Work of breathing – Lung compliance, Airway resistance, Gas exchange and transport, Oxygen dissociation curve, Lung surfactant, Pulmonary pathologies, Space Medicine –Hypoxia, Physiology of decompressive sickness, Human response to acceleration, Thermal Stress.

UNIT V COMPUTATIONAL FLUID DYNAMICS 9

Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection-Diffusion Problems, Solution Algorithms for Pressure-Velocity Coupling in steady flows, Solution of Discretized Equations, The Finite Volume Method for Unsteady flows, Implementation of Boundary Conditions Application – Multiphysics computational models for cardiac flow and virtual cardiography.

Total No of Periods: 45

TEXT BOOKS:

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, ―Biofluid Mechanics- Thehuman circulation‖, CRC Taylor and Francis, 2007.
2. Y.C Fung, ―Biomechanics- Mechanical properties of living tissues‖, 2nd Edition, Springer-Verlag, 1993.
3. Jeffery R. Davis et. Al., ―Fundamentals of Aerospace Medicine‖, Wolter Kluwer Health,Lippincott Williams and Wilkins, 2008

REFERENCE BOOKS:

1. Jung HeeSeo, Vijay Vedula, Theodore Abraham and Rajat Mittal, ―Multiphysics computational models for cardiac flow and virtual cardiography‖, Int. J. Numer. Meth. Biomed.Engg. (2013) Published online in Wiley Online Library.
2. Lee Waite, Jerry Fine, ―Applied Biofluid Mechanics‖, McGraw Hill, 2007.
3. John K-J Li, ―Dynamics of Vascular System‖, World Scientific, 2004.
4. C. Ross Ethier, Craig A Simmons, ―Introduction to Biomechanics- From Cells to Organisms‖,Cambridge Texts in Biomedical Engineering, 2007.
5. H K Versteeg, W Malalasekera, ―An Introduction to Computational Fluid Dynamics TheFinite Volume Method‖, Longman Scientific and Technical, 1995

PROGRAM ELECTIVE – II

Course Code: EBBM22E05	Course Name: TISSUE ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Human Anatomy and Physiology	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To identify the key related terms to tissue engineering
- To elaborate the concept of cell expansion
- To conduct experiments on tissue engineering
- To perform analysis on the hormonal growth factor
- To follow the safety guidelines

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Identify the key related terms to tissue engineering
CO2	Elaborate the concept of cell expansion
CO3	Conduct experiments on tissue engineering
CO4	Perform analysis on the hormonal growth factor
CO5	Follow the safety guidelines

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	2	3	2
CO3	3	2	2
CO4	2	1	3
CO5	1	2	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E05	Course Name: TISSUE ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Human Anatomy and Physiology	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9

Basic definition - Structural and organization of tissues – Epithelial – connective - vascularity and angiogenesis - basic wound healing - cell migration - current scope of development and use in therapeutic and in-vitro testings

UNIT II CELL CULTURE 9

Different cell types - progenitor cells and cell differentiations - different kind of matrix - cell-cell interaction - Aspect of cell culture - cell expansion - cell transfer - cell storage and cell characterization - Bioreactors

UNIT III MOLECULAR BIOLOGY ASPECTS 9

Cell signaling molecules - growth factors - hormone and growth factor signaling - growth factor delivery in tissue engineering - cell attachment: differential cell adhesion - receptor-ligand binding - Cell surface markers.

UNIT IV SCAFFOLD AND TRANSPLANT 9

Engineering biomaterials for tissue engineering - Degradable materials – porosity - mechanical strength - 3-D architecture and cell incorporation - Engineering tissues for replacing bone – cartilage –tendons – ligaments - skin and liver - Basic transplant immunology - stems cells - hepatopoiesis.

UNIT V CASE STUDY AND REGULATORY ISSUES 9

Case study of multiple approaches - cell transplantation for liver – musculoskeletal – cardiovascular – neural - visceral tissue engineering – Ethical - FDA and regulatory issues of tissue engineering.

Total No of Periods: 45

TEXT BOOK

1. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008

REFERENCE BOOKS:

1. P.Lanza, Robert Langer & William L. Chick, Principles of tissue engineering, Robert. Academic press.
2. Joseph D. Bronzino, The Biomedical Engineering –Handbook, CRC press.
3. Endarle, Blanchard &Bronzino, Introduction to Biomedical Engg. , Academic press.
4. B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, Tissue Engineering, CRC- Taylor & Francis

Course Code: EBBM22E06	Course Name : COMPUTER NETWORKS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn about Transmission media, Data encoding, Interface and Modems
- To learn about Multiplexing clear view ISO – OSI layered architecture
- To learn about Frames relay operation – layers and traffic control
- To learn about ATM networks. LAN topology, Ethernet, Token bus
- To learn about Token ring, FDDI, Wireless LAN

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	To learn about transmission media, data encoding, interface and modems, Multiplexing
CO2	To get a clear view of ISO – OSI layered architecture
CO3	To learn about Frames relay operation – layers and traffic control; ATM networks
CO4	To clear view LAN topology, Ethernet, Token bus, Token ring, FDDI, Wireless LAN
CO5	To learn about Transport layer issues, session layer, Synchronization, Presentation layer

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	3	1
CO3	3	2	1
CO4	1	2	3
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E06	Course Name : COMPUTER NETWORKS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I DATA COMMUNICATION CONCEPTS 9

Transmission media - Data encoding - Interface and Modems - Multiplexing - Error detection and correction - Digital subscriber line - Circuit switching - Packet switching - Message switching.

UNIT II WIDE AREA NETWORKS 9

ISO - OSI layered architecture - Function of the layers - Data link protocols - HDLC - LAPB - LAPD -Inter networking devices - Repeaters – Bridges - Routers - Routing algorithms - Distance vector routing- link state routing - X.25 protocol - congestion control

UNIT III FRAME RELAY AND ATM NETWORKS 9

Frames relay operation - layers and traffic control - ATM networks - Architecture switching - layers service classes

UNIT IV LOCAL AREA NETWORK 9

LAN topology - Ethernet - Token bus - Token ring - FDDI - Wireless LAN - ATM LAN - IEEE 802 Medium access control layer standard - Random access protocols - ALOHA - Slotted ALOHA

UNIT V OSI LAYERS 9

Transport layer issues - Session layer - Synchronization - Presentation layer - Encryption- decryption - Application layer - Message handling system - file transfer - virtual terminal - Email.

Total No of Periods: 45

TEXT BOOKS:

1. William Stallings, “Data and Computer Communication”, sixth edition, Pearson education Asia, 2000

REFERENCE BOOKS:

1. Behrouz A, Forouzan, “Data Communication and Networking”, second edition, Tata McGraw-Hill, 2000.
2. Fred Halsall, “Data Communication, Computer networks and Open Systems”, Fourth edition, Addison Wesley, 1995
3. Andrew S.Tanenbaum, “Computer networks”, Third edition, PHI, 1996

Course Code: EBBM22E07	Course Name : DRUG DELIVERY SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To educate the student on drug delivery system which would enable a comprehensive analysis
- Give direction of these drug delivery systems as an important tool in improving the efficacy
- Safety of the release of drugs in the body
- Explores the present and future strategies within the drug delivery market.
- Understands Implementation of plans and method

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	The graduate can know about drug delivery system which would enable a comprehensive analysis
CO2	Capable of giving these drug delivery systems as an important tool in improving the efficacy
CO3	Understands safety of the release of drugs in the body
CO4	Graduates can understand about present and future strategies within the drug delivery market.
CO5	Understands Implementation of plans and method

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	2	3	1
CO3	3	3	3
CO4	2	2	3
CO5	3	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E07	Course Name : DRUG DELIVERY SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I SUSTAINED AND CONTROLLED DRUG DELIVERY 9

Introduction - properties of drugs - Pharmacokinetic properties of drugs - sustained release formulations - concept - physicochemical biological properties of drug - advantages and disadvantages - controlled drug delivery systems - automatically controlled drug delivery systems and their biomedical applications

UNIT II POLYMERS & TARGETTED DRUG DELIVERY SYSTEMS 9

Polymers used in drug delivery systems - modules - classification- characterization - advantages and disadvantages of polymer - targeted drug delivery systems - concepts - nanoparticles - liposomes - microspheres - hydrogels

UNIT III TRANSDERMAL DRUG DELIVERY SYSTEMS 9

Transdermal penetration of drugs - formulation - addition - polymers in transdermal drug delivery system - iontophoresis - transdermal controlled release products and devices

UNIT IV IMPLANTABLE DRUG DELIVERY SYSTEMS 9

Implantable micro - pump systems - peristaltic micro pump - osmotic micro pump - diaphragm micro pump - Fluorocarbon propellent driven micro pump - solenoid driver reciprocates micro pump - programmable implanted drug administrative device (DAD)

UNIT V SITE SPECIFIC DRUG DELIVERY SYSTEMS 9

Development in insulin therapy using biomedical controlled drug delivery systems - drug delivery using monoclonal antibodies - role of biosensors and transducers in diagnostic

Total No of Periods: 45

TEXT BOOKS:

1. Vyas S. P. Khar R. K.,"Targetted and controlled drug delivery Novel Carrier System CBSPD", 2006
2. Anya M Hillery et. al.,"Drug delivery and targeting", CRC press, 2000

REFERENCE BOOKS:

1. Robinson R Robinson,"Conventional drug delivery systems", CRC press, 2004

Course Code: EBBM22E08	Course Name: RADIOLOGICAL EQUIPMENTS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Diagnostic and Therapeutic Equipments	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To understand the generation of X-ray and its uses in imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To know about PET and SPECT Imaging.

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Describe the working principle of X ray machine and its application.
CO2	Illustrate the principle of computed tomography.
CO3	Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging
CO4	Demonstrate the applications of radio nuclide imaging.
CO5	Understand PET and SPECT Imaging.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	2	3	1	2	3			
CO2	2	1	3	2	3			
CO3	3	1	2	3	1			
CO4	1	2	2	1	2			
CO5	3	2	1	3	2			

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E08	Course Name: RADIOLOGICAL EQUIPMENTS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Diagnostic and Therapeutic Equipments	Ty	3	0/0	0/0	3

UNIT I MEDICAL X-RAY EQUIPMENT 9

Nature of X-rays- X-Ray absorption – Tissue contrast - X- Ray Equipment (Block Diagram) -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 Fluoroscopy – Digital Fluoroscopy. Angiography, Mammography and Dental x-ray unit.

UNIT II COMPUTED TOMOGRAPHY 9

Principles of tomography, Evolution of CT machines, X- Ray sources- collimation- X- Ray detectors- Viewing systems- spiral CT scanning – Ultra fast CT scanners. CT image formation- Conversion of X-ray data into scan image, Mathematical details of various algorithms Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application.

UNIT III MAGNETIC RESONANCE IMAGING 9

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR MEDICINE TECHNIQUES 9

Nuclear imaging – Anger scintillation camera –Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances. Radionuclide imaging- Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques- hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting

UNITV 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.

Total No of Periods: 45

Text Books:

1. Steve Webb, ―The Physics of Medical Imaging‖, Adam Hilger, Philadelpia, 1988
2. John Ball and Tony Price Chesney's, "Radiographic Imaging". Blackwell Science Limited, U.K. 2006.
3. Farr, "The Physics of Medical Imaging", AdemHilger, Bristol & Philadelphia, 2007.
4. Joseph Bronzino. "The Physics of Medical Imaging". Second edition.2005.

Reference Books:

1. Gopal B. Saha ―Physics and Radiobiology of Nuclear Medicine‖- Third edition Springer, 2006.
2. M. Analoui, J.D. Bronzino, D.R.Peterson, "Medical Imaging: Principles and Practices", CRC Press, 2012.
3. S. Webb, "Physics of Medical Imaging", Taylor & Francis, 2010.
4. P.Ragunathan, ―Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques‖,Paperback – Import, 2007

PROGRAM ELECTIVE – III

Course Code: EBBM22E09	Course Name: MEDICAL INFORMATICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Gain Knowledge on Biomedical Information Technology
- To Learn About Overview of Computer Hardware
- To Study About Hospitals Information Systems
- To Gain Knowledge on Visual Programming and Multimedia Information Systems
- To Learn About Integrated Medical Information Systems

COURSE OUTCOMES (COs) : (3- 5) Student able to

CO1	Acquires Knowledge on Biomedical Information Technology
CO2	Acquires Knowledge on Overview of Computer Hardware
CO3	Acquires Knowledge on Hospitals Information Systems
CO4	Acquires Knowledge on Visual Programming and Multimedia Information Systems
CO5	Acquires Knowledge on Integrated Medical Information Systems

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	3	2	1
CO3	1	2	3
CO4	2	1	2
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E09	Course Name: MEDICAL INFORMATICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I BIOMEDICAL INFORMATION TECHNOLOGY 9

Historical highlights of Healthcare Information systems - Biomedical Information systems - problems and pitfalls - History and evolution of Electric resources - Internet and Interactive Multimedia components

UNIT II OVERVIEW OF COMPUTER HARDWARE 9

Motherboard and its logic - memory and I/O interfacing -memory and I/O mapI/O peripherals - add-on cards -RS 232-C - various IEEE standards

UNIT III HOSPITALS INFORMATION SYSTEMS 9

Concept of HIS and its Position on the hospital - introduction of a computerized HIS-application of HIS in project management - Automation of Medical record - hospital Inventory data protection aspects - costs and benefits of HIS - transfer of information within the hospital - Modems and computer networking in Hospitals

UNIT IVVISUAL PROGRAMMING AND MULTIMEDIA INFORMATION SYSTEMS 9

Visuals Basic principles and programming – Design - Production and testing of multimedia based medical information systems

UNIT V INTEGRATED MEDICAL INFORMATION SYSTEMS 9

Integration of Intra and Inter hospital information systems - Role of expert systems and fuzzy logic in medical information systems - Physiological system modeling and simulation - Concepts of Virtual reality -web based multimedia information systems - video conferencing

Total No of Periods: 45

TEXT BOOKS:

1. S.K. Chauhan, . “PC Organisation”, S.K. Kataria and sons, Delhi.
2. Haroidsackman, “Biomedical Inforamtion Technology”, Academic Press, New York, 1997

REFERENCE BOOKS:

1. Mary Beth Fecko, “Electronic Resources: Access and Issues, Bowker-saur, London, 1997
2. R.D. Lele, “Computers in medicine”, Tata McGraw Hill, New Delhi, 1999
3. Tay Vaughan, “Multimedia making it work”, Tata McGRaw Hill, New Yotk, 1999
4. Mark Spenik, “Visual Basic 6, Iterative Course”, Techmedia, New Delhi, 1999

Course Code: EBBM22E10	Course Name : PRINCIPLES OF ROBOTICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the basic concepts and parts of robots.
- Understanding the working of robots and various types of robots.
- Familiarizing with the various drive systems of robots, sensors and their applications in robots and programming of robots.
- The various applications of robots, justification and implementation of robots.
- Studying about the manipulators, activators and grippers and their design considerations

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Understands the basic concepts and parts of robots.
CO2	Understanding the working of robots and various types of robots.
CO3	Familiarized with the various drive systems of robots, sensors and their applications in robots and programming of robots.
CO4	Capable of knowing the various applications of robots, justification and implementation of robots.
CO5	Understands the concept of the manipulators, activators and grippers and their design considerations

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	2	1	3
CO3	1	3	2
CO4	2	3	1
CO5	2	3	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E10	Course Name : PRINCIPLES OF ROBOTICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics - different types of robotics - various generations of robots - degrees of freedom - Asimov's laws of robotics - dynamic stabilization of robots

UNIT II POWER SOURCES AND SENSORS 9

Hydraulic - pneumatic and electric drives - determination of HP of motor and gearing ratio - variable speed arrangements - path determination - micro machines in robotics - machine vision - ranging - laser - acoustic – magnetic -fiber optic and tactile sensors

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS 9

Construction of manipulators - manipulator dynamics and force control - electronic and pneumatic manipulator control circuits - end effectors - U various types of grippers - design considerations

UNIT IV KINEMATICS AND PATH PLANNING 9

Solution of inverse kinematics problem - multiple solution jacobian work envelop - hill climbing techniques - robot programming languages

UNIT V CASE STUDIES 9

Multiple robots - machine interface - robots in manufacturing and non-manufacturing applications - robot cell design - selection of robot

Total No of Periods: 45

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", McGraw-Hill Singapore, 1996
2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998

REFERENCE BOOKS:

1. Deb.S.R., "Robotics technology and flexible Automation", John Wiley, USA 1992
2. AsfahlC.R.,"Robots and manufacturing Automation", John Wiley, USA 1992
3. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994
4. McKerrowP.J.,"Introduction to Robotics", Addison Wesley, USA, 1991
5. IssacAsimov,"I Robot", Ballantine Books, New York, 1986

Course Code: EBBM22E11	Course Name: GENETIC ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand the basics of genetics
- To understand the working of chromosomes
- To understand the concepts of alleles
- To give an insight to crossing over& gene transfer
- To study about the genetics and biotechnology

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Identify the basics of genetics
CO2	Illustrate and pictorise the working of chromosomes
CO3	elaborate the concepts of alleles
CO4	Analyze on the crossing over& gene transfer
CO5	Conduct experiments on genetics and biotechnology

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	2	3	1
CO3	3	3	3
CO4	2	3	1
CO5	1	2	2

H/M/L indicates Strength of Correlation H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E11	Course Name: GENETIC ENGINEERING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I BASICS OF GENETICS 9

Classical genetics- Mendelian Laws- Mendel's experiment-monohybrid cross-phenotype- genotype- Dihybrid inheritance- Interaction of genes- Fine structure of Genes - Chromosome structure and organization in prokaryotes and eukaryotes- unusual chromosomes chromosome banding- chromosome abnormalities- genetic disorders

UNIT II ALLELES 9

Classical concepts of Pleomorphism- Multiple alleles- ABO blood groups- Rh factor- sex linkage in Drosophila- linkage in human beings- mechanism of sex determination- XX-XY mechanisms of sex determination- sex determination in Drosophila- environmental factors and sex determination- sex differentiation.

UNIT III CROSSING OVER AND GENE TRANSFER 9

Coupling and Repulsion-Hypothesis- Test cross in maize and crossing over- theory of crossing over- molecular mechanism of crossing over- sex chromosomes and sex linked inherited disorders-colour blindness- hemophilia- Muscular dystrophy Transformation-Transduction- Conjugation- Plasmids and Episomes

UNIT IV GENETICS AND BIOTECHNOLOGY 9

Introduction- industrial genetics- protoplast and cell fusion technologies- genetic engineering- Introduction to Bio-informatics- potential lab biohazards of genetic engineering- Bioethics.

UNIT V RECOMBINANT DNA 9

Concept of recombinant DNA technology and purpose, basic methodology, use of plasmids, Type I, II and III restriction modification systems, type II restriction endonucleases, nomenclature and sequence recognition, MCR and RNRR genotypes, linkers, adaptors, blunt end ligation, homopolymeric tailing, Transformation, methods in screening recombinant DNA.

Total No of Periods: 45

TEXT BOOKS:

1. Gardner- Simmons and Snustad, "Principles of Genetics", John Wiley and Sons (Asia), 2002
2. Lewin, "Genes VIII", International Edition, Prentice Hall, 2004

REFERENCE BOOKS:

1. P.C. Winter- G.I. Hickey and H.L. Fletcher, "Instant Notes in Genetics", Viva Books Private Limited, 2003.

Course Code: EBBM22E12	Course Name :MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMEDICAL INSTRUMENTATION	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide adequate technical information on basics of trouble shooting procedure
- To understand the basics of testing of devices
- To attain mastery in fault detection
- To understand the troubleshooting of biomedical equipment
- To understand the troubleshooting of advanced equipment.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attain adequate technical information on basics of trouble shooting procedure
CO2	Understand the basics of testing of devices
CO3	Attain mastery in fault detection
CO4	Understand the troubleshooting of biomedical equipment
CO5	Understand the troubleshooting of advanced equipment

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	3	2	1
CO3	1	1	2
CO4	2	1	3
CO5	1	1	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E12	Course Name :MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMEDICAL INSTRUMENTATION	Ty	3	0/0	0/0	3

UNIT I BASIC OF TROUBLESHOOTING PROCEDURES 9

Troubleshooting Process and Fault-finding Aids- Troubleshooting Techniques- Grounding Systems in Electronic Equipment- Temperature Sensitive Intermittent Problems-Correction Action - repair the Equipment

UNIT II TESTING OF DEVICES 9

Testing procedure of electronic components- causes of failure for electronic components- testing procedure of special diodes- bipolar transistors- field effect transistor (FET)- thyristor

UNIT III FAULT DIAGNOSIS INCIRCUITS 9

Fault Diagnosis Circuits- Digital Troubleshooting Methods- Circuit board Troubleshooting

UNIT IV BIOMEDICAL EQUIPMENT I TROUBLESHOOTING 9

Trouble shooting of ECG Machine- EEG Machine- EMG Machine - Defibrillator Electrosurgical unit- Anesthesia machine- Autoclaves and sterilizers- Endoscope

UNIT V BIOMEDICAL EQUIPMENT II TROUBLESHOOTING 9

Troubleshooting of Incubators –Nebulizer- Oxygen Concentrators- Oxygen cylinders and flow meters- Pulse Oximeter –Sphygmomanometers- Suction Machine- X-Ray Machine Troubleshooting- Patient Monitoring Machine troubleshooting

Total No of Periods: 45

TEXT BOOKS:

1. Khandpur R S, “Troubleshooting Electronic Equipment- Includes Repair and Maintenance”, Tata McGraw-Hill, Second Edition 2009
2. Dan Tomaland Neal Widmer, “Electronic Troubleshooting”, McGraw Hill, 3rd Edition 2004.

REFERENCE BOOKS:

1. Nicholas Cram and Selby Holder, “Basic Electronic Troubleshooting for Biomedical Technicians”, TSTC Publishing, 2nd Edition, 2010
2. World Health Organisation, “Maintenance and Repair of Laboratory, Diagnostic imaging and Hospital Equipment”, Geneva, 1994
3. Ian R, McClelland,“X-ray Equipment maintenance and repairs workbook for Radiographers and Radiological Technologists”, World Health Organisation, Geneva, 2004
4. Ministry of Health and Family Welfare, “Medical Equipment Maintenance Manual- A first line maintenance guide for end users”, New Delhi, October 2010
5. Joseph.J, Panichello, “X-Ray Repair: A Comprehensive Guide to the Installation and Servicing of Radiographic Equipment”, Charles C Thomas Publisher Ltd, 2nd Edition, 2005

PROGRAM ELECTIVE – IV

Course Code: EBBM22E13	Course Name: ELECTRICAL SAFETY AND QUALITY ASSURANCE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To know about electrical safety
- To study standards and requirements
- To study about electrical protection and maintenance
- To know about standardization of quality medical care in hospitals
- To know about regulatory requirement for health care

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Know about electrical safety
CO2	Know about standards and requirements
CO3	Know about electrical protection and maintenance
CO4	Know about standardization of quality medical care in hospitals
CO5	Know about regulatory requirement for health care

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	1	2
CO3	1	2	3
CO4	2	3	2
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E13	Course Name: ELECTRICAL SAFETY AND QUALITY ASSURANCE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I ELECTRICAL HAZARDS 11

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion –Human interface with electricity – Human resistance to electricity

UNIT II STANDARDS AND REQUIREMENTS 11

National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Classification of electrical equipment for hazardous areas (IS, NFPA, API and OSHA standards).

UNIT III ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation (CPR).

UNIT IV STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 7

Define Quality- Need for Standardization& Quality Management, QM in Health care organization- Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipment

UNIT IV REGULATORY REQUIREMENT FOR HEALTH CARE 7

CE and FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Indian Boiler act - Other regulatory Codes.

Total No of Periods: 45

TEXT BOOKS:

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 24
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere& Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.
3. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.

REFERENCES:

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.
2. Karen Parsley, Karen Parsley Philomena Corrigan‖ Quality improvement in Healthcare, 2nd edition, Nelson Thrones Pub, 2002
3. Sharon Myers ―Patient Safety & Hospital Accreditation - A Model for Ensuring Success‖ Springer Publishers 2012 7. Joseph F Dyro ―Clinical Engineering Handbook― Elsevier Publishers, 2004

Course Code: EBBM22E14	Course Name: HOSPITAL MANAGEMENT	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Learn about need and scopes of clinical engineering
- To gain knowledge on training and management of technical staff in hospital
- To study about training and management of technical staff in hospital
- To learn about standards and codes in health care
- To gain knowledge on computer in medicine

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands need and scopes of clinical engineering
CO2	Acquires training and management of technical staff in hospital
CO3	Graduate understands training and management of technical staff in hospital
CO4	Understands standards and codes in health care
CO5	Understands computer in medicine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	3	1
CO3	3	2	1
CO4	1	2	3
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E14	Course Name: HOSPITAL MANAGEMENT	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I NEED AND SCOPES OF CLINICAL ENGINEERING 9

Clinical engineering program - educational responsibilities - role to be performed by them in hospital - staff structure in hospital

UNIT II NATIONAL HEALTH POLICIES 9

Need for evolving health policy - health organization in state - health financing system - health education - health insurance - health legislation

UNIT III TRAINING AND MANAGEMENT OF TECHNICAL STAFF IN HOSPITAL 9

Difference between hospital and industrial organization - levels of training - steps of training - developing training program - evaluation of training - wages and salary - employee appraisal method

UNIT IV STANDARDS AND CODES IN HEALTH CARE 9

Necessity for standardization – FDA - Joint Commission on Accreditation of hospitals - ICRP and other standard organization - methods to monitor the standards

UNIT V COMPUTER IN MEDICINE 9

Computer application in ICU - X-Ray department - laboratory administration - patient data - medical records – communication - simulation

Total No of Periods: 45

TEXT BOOKS:

1. Webster J.C. and Albert M.Cook, “Clinical Engineering Principle and Practice”,Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979

REFERENCE BOOKS:

1. Goyal R.C., “Handbook of hospital personal management”, Prentice Hall of India, 1996

Course Code: EBBM22E15	Course Name: IoT FOR BIOMEDICAL SECTOR	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IoT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To Analyse applications of IoT in real time scenario

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Understand Smart Objects and IoT Architectures
CO2	Analyse various protocols for IoT.
CO3	Build simple IoT Systems using Arduino and Raspberry Pi.
CO4	Understand data analytics and cloud in the context of IoT
CO5	Analyse applications of IoT in real time scenario

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	2	2	3
CO3	1	3	2
CO4	2	1	2
CO5	1	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E15	Course Name: IoT FOR BIOMEDICAL SECTOR	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem.

UNIT II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT IIIDESIGN AND DEVELOPMENTUSING ARDUINO AND RASPBERRY PI. 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

Total No of Periods: 45

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCE BOOKS:

1. ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015 2
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.

Course Code: EBBM22E16	Course Name :LASER AND ULTRASONIC APPLICATION IN MEDICINE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Gain Knowledge on LASER
- To Study About Ultrasonic
- To Learn About Ultrasonic Scanners
- To Study About High Energy Ultrasonic
- To Gain Knowledge of Holographic Application in Medicine

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires Knowledge of LASER
CO2	Graduate acquires knowledge on Ultrasonic
CO3	Capable to analyze Ultrasonic Scanners
CO4	Understands High Energy Ultrasonic
CO5	Acquires knowledge on Holographic Application inMedicine

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	1	3
CO3	3	2	1
CO4	2	3	1
CO5	1	2	3

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E16	Course Name :LASER AND ULTRASONIC APPLICATION IN MEDICINE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I LASER `9

Principles of Laser action -different types and of lasers and its operation -Applications of Laser in Biology -Dentistry, Ophthalmology –Dermatology –Medicine –Surgery -Interferometer Applications -Fluorescence studies in cancer Diagnosis -Laser in Genetic Engineering -Low power applications in Medicine

UNIT II ULTRASONICS 9

Different Modes of Display - A, B, C -scanning Techniques -Absorption in biological Tissues -Measurement of Ultrasonic Energy -Construction of Ultrasonic probe -Ultrasonic Imaging in Abdomen –Breast –Heart –Chest –Eye –Kidney –Skull -Pulsatile Motion -Pregnant and non-Pregnant uterus

UNIT III ULTRASONIC SCANNERS 9

Real Time Echo -2D Scanners -Colour Doppler

UNIT IV HIGH ENERGY ULTRASONICS 9

Effects due to High energy ultrasonics applications in Surgery -Cell destruction -Cleaners

UNIT V HOLOGRAPHIC APPLICATION IN MEDCINE 9

Wave front Recording and Reconstruction -Recording Media -Image forming application -Motion Induced Constrast -correlation filtering -Holograms using Ultrasonic signals and Hologram using Lasers

Total No of Periods: 45

TEXT BOOKS:

1. Leon Goldman, M.D., and R. Jamies Rockwell, Jr.,“Lasers in medicine Gordon and breach”,science publishers Inc., New York, 1971
2. Brown Y.H.V. and Dickson J.F. (Eds), “Advances in Bio – Medical Engineering”, Volume II and V, Academic press, London, 1972
3. Georg W. Stroke, Kock W.E., “Ultrasonic Imaging and Holography”,plenum press, New York, 1974
4.

REFERENCE BOOKS:

1. Mertellucci S. Sand Chester A.N.,“Laser Photo biology and photo medicine”,plenum press, New York, 1989.
2. Wolbarsht M.L., “Laser Application in Medicine and Biology”, Plenum press, New York, 1989

PROGRAM ELECTIVE – V

Course Code: EBBM22E17	Course Name: FORENSIC SCIENCE IN HEALTHCARE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To know animal cell structure
- To study blotting technique
- To acquire basic knowledge on fingerprint
- To know about toxins
- To study serological and chromosomal techniques

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Know about animal cell structure
CO2	Knowabout blotting technique
CO3	Analyse fingerprint
CO4	Know about toxins
CO5	Get knowledge on serological and chromosomal techniques

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	2	3
CO3	2	3	1
CO4	3	2	2
CO5	2	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E17	Course Name: FORENSIC SCIENCE IN HEALTHCARE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I ANIMAL CELL STRUCTURE 9

Cell and its inclusions–structure and function, Blood and Body fluids–forensic significance–morphological identification of bones–forensic importance.

UNIT II BLOTTING TECHNIQUES 9

Identification of Human remains–methods of reconstruction–personal identity in the living and the dead– DNA finger printing–RFLP, RAPD, PCR-Blotting types(Southern, Northern and Western) – forensic importance.

UNIT III FINGERPRINT 9

Finger Prints–importanceofplasticandvisiblefingerprints–transfermethodsoffingerprints–fingerprint patterns – their classification – ridge characteristics –Biometric-Iris, facial characterization- foot prints – importance – photography of footprints–sunken and surface footprints, gait patterns and their characteristics.

UNIT IV TOXINS 9

Forensic toxicology – poison and drugs, classifications, Source, nature, Actions and diagnosis of poisoning cases, post-mortem findings and examination, treatment of poisoning cases, medicolegal aspects; corrosive agents, irritants.

UNIT V SEROLOGICAL ANDCHROMOSOMALTECHNIQUES 9

Serology–basic principles of serology – concept of antigen and antibody and their reaction – application of serology in forensic science. Karyotyping–banding patterns–-chromosomal abnormalities–sex determination–barr bodies – sex linked inheritance.

Total No of Periods: 45

TEXT BOOKS:

1. DeRobertis, General Cytology, Sannders, 6th Edition, 2008.
2. ApurbaNandy, Principles of Forensic Medicine, New Central Book Agency, 2nd Edition, 2001.
3. M.Krawczakand J. Schmidtke, DNA Finger printing, BIOS Scientific Publisher, 2nd Edition, 2000.

REFERENCE BOOKS:

1. Richard Saferstein Ed, Forensic Science Hand Book, Prentice Hall, 2010.
2. Narayan Reddy, The Essential of Forensic Medicine and Toxicology, 31st Edition, 2012.

Course Code: EBBM22E18	Course Name: VR AND AR IN HEALTHCARE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand the system or process to meet given specifications with realistic engineering constraints.
- To understands the modelling process in VR
- To explore the technical resources
- To examine the content and mobile applications of VR.
- To design various medical applications based on augmented reality.

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Understands the system or process to meet given specifications with realistic engineering constraints.
CO2	Understands the modelling process in VR
CO3	Explores the technical resources
CO4	Examine the content and mobile applications of VR.
CO5	Design various medical applications based on augmented reality.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	2	2	3
CO3	1	1	3
CO4	3	2	1
CO5	1	3	2

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E18	Course Name: VR AND AR IN HEALTHCARE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9

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

UNIT II MODELLING IN VR 9

Geometric modelling - kinematics modelling- physical modelling - behaviour modelling - Model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR 9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB AND VR ON THE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events) frameworks (A-frame, React VR)- Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNIT V APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications- games, movies, simulations, therapy

Total No of Periods: 45

TEXT BOOKS:

1. C. Burdea& Philippe Coiffet, ―Virtual Reality Technology‖ , Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machineryand Morgan & Claypool, New York, NY, USA, . 2015.
3. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg& Tobias Hollerer, Pearson Education(US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.

REFERENCE BOOKS:

1. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O‘Reilly Media; 1 edition, 2015.

Course Code: EBBM22E19	Course Name: WEARABLE SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To describe different sensors used in physiological system measurements
- To understand the bio signal acquisition methods and signal processing methods for human systems
- To analyze the usage of optimized energy techniques for wearable devices
- To evaluate the wireless Tele health technology for applications
- To executing the specified wearable systems for respective physiological systems.

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Describe different sensors used in physiological system measurements
CO2	Understand the bio signal acquisition methods and signal processing methods for human systems
CO3	Analyze the usage of optimized energy techniques for wearable devices
CO4	Evaluate the wireless Tele health technology for applications
CO5	Executing the specified wearable systems for respective physiological systems.

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	1	3
CO3	3	1	2
CO4	1	2	2
CO5	3	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E19	Course Name: WEARABLE SYSTEMS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I SENSORS FOR WEARABLE SYSTEMS 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, Radiant thermal sensor, Wearable motion sensors, Wearable biochemical Sensors, Wearable gas sensors, E-Textiles.

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, Datamining

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 WEARABLE DEVICES FOR HEALTHCARE 9

Wearable ECG devices, Wearable EEG devices, Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement – wearable surface electrodes, Smart textile for neurological rehabilitation system (NRS), Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor, Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring.

Total No of Periods: 45

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Hang,Yuan-Ting, "Wearable Medical Sensors and Systems",Springer-2013
2. Mehmet R. Yuce, Jamil Y.Khan,"WirelessBodyAreaNetworksTechnology,Implementation and Applications " , Pan Stanford Publishing Pvt. Ltd, Singapore,2012
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer,2006
4. Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands,2004

Course Code: EBBM22E20	Course Name: INTELLECTUAL PROPERTY RIGHTS AND BIOSAFETY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To make the student understand Introduction to Intellectual Property
- To impart knowledge on basics of Patents and Concept of Prior Art.
- To impart knowledge on Patent filing procedures
- To educate on Biosafety
- To introduce the Biosafety guidelines

COURSE OUTCOMES (COs): (3- 5) Students will be able to

CO1	Understand Introduction to Intellectual Property
CO2	Impart knowledge on basics of Patents and Concept of Prior Art.
CO3	Impart knowledge on Patent filing procedures
CO4	Acquire knowledge on Biosafety
CO5	Acquire knowledge on Biosafety guidelines

Mapping of Course Outcomes with Program Outcomes (POs)

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

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	3	2
CO3	3	2	3
CO4	2	2	3
CO5	2	2	1

3/2/1 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary		
					✓							

Course Code: EBBM22E20	Course Name: INTELLECTUAL PROPERTY RIGHTS AND BIOSAFETY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY 9

Types of IP: Patents- Trademarks- Copyright & Related Rights- Industrial Design- Traditional Knowledge- Geographical Indications- Protection of GMOs- IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; History of GATT & TRIPS Agreement; Madrid Agreement; Hague- Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent- Act 1970 & recent amendments.

UNIT II BASICS OF PATENTS AND CONCEPT OF PRIOR ART 9

Introduction to Patents; Types of patent applications: Ordinary-PCT- Conventional- Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching- International Databases; Country-wise patent searches (USPTO-esp@cenet(EPO)-PATENT Scope(WIPO)- IPO- etc.)

UNIT III PATENT FILING PROCEDURES 9

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting -introduction to existing schemes- Patent licensing and agreement- Patent infringement- meaning- scope- litigation- case studies.

UNIT IV BIOSAFETY 9

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;

UNIT IV BIOSAFETY GUIDELINES 9

Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee- RCGM- GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; overview of National Regulations and relevant International Agreements including Cartegana Protocol.

Total No of Periods: 45

TEXT BOOKS:

1. BAREACT Indian Patent Act 1970 Acts & Rules- Universal Law Publishing Co. Pvt. Ltd.- 2007
2. Kankanala C, Genetic Patent Law & Strategy- 1st Edition-Manupatra Information Solution Pvt. Ltd.- 2007

REFERENCES:

1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets‖, Cengage Learning, Third Edition, 2012.
2. http://www.w3.org/IPR/
3. http://www.wipo.int/portal/index.html.en

Course Code: EBEE22OE1	Course Name: ELECTRICAL SAFETY FOR ENGINEERS	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To attain knowledge on Electrical Safety
- To know about the operation of Electrical Safety Equipments
- To learn about the safety procedures
- To know about the electrical safety codes
- To train the students on the Safety training.

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Attained knowledge on the basics of Electrical Safety
CO2	Knowledge about the operation of the Safety equipments
CO3	Knowledge on the safety procedures
CO4	Familiarity on the electrical safety codes
CO5	Ability to become consultant and to attend the Vendors.

Mapping of Course Outcome with Program Outcome (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**
CO2	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**2**	**1**
CO4	**3**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**2**
CO5	**1**	**2**	**2**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

COs /PSOs	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**
CO2	**3**	**2**	**2**
CO3	**2**	**3**	**3**
CO4	**3**	**2**	**2**
CO5	**2**	**1**	**2**

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						√			

Course Code: EBEE22OE1	Course Name: ELECTRICAL SAFETY FOR ENGINEERS	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I HAZARDS OF ELECTRICITY 9

Introduction – Hazards Analysis – Shock – Shock Effect – Arc –arc energy release-Arc energy-Arcing voltage-Arc surface Area-Incident Energy-Arc Flash Effect – Blast – Affected body parts – Summary of causes –Injury and Death – Protective Strategies.

UNIT II ELECTRICAL SAFETY EQUIPMENT 9

General Inspection and Testing Requirement for Electrical Safety Equipment – Flash and Thermal Production – Head and Eye Protection – Rubber Insulating Equipment –Hot Sticks-Barrier and signs-Insulated Tools –Safety Grounding Equipment – Electricians Safety Kit.

UNIT III SAFETY PROCEDURES AND ORGANIZATIONAL METHODS 9

Six Step Safety Methods – Safe Switching of Power System – Voltage measurement Techniques – Placement of Safety Grounds – Tools And Test Equipment – One Minute Safety Audit-Electrical Safety program Development – Employee Electrical Safety Teams – Safety Meetings – Outage Reports – Safety Audits.

UNIT IV REGULATORY AND LEGAL SAFETY REQUIREMENTS AND STANDARDS 9

Regulatory Bodies-ANSI-IEEE-Electrical safety code –Standards for Electrical safety in the workplace-Accident prevention-first aid –Rescue Techniques-accident invention.

UNIT V SAFETY TRAINING METHODS AND SYSTEMS 9

Introduction – Elements of a good Training Program – On the Job Training – Training Consultants and Vendors- Training Program Setup – Step by Step Method

Total No. of Periods: 45

Text Book:

1. Electrical safety handbook - John Cadick - McGRAW-HILL, Third Edition

Course Code: EBEE22OE2	Course Name: ENERGY CONSERVATION TECHNIQUES	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To study about introduction to the Energy Conservation Technology
- To know the working Principle of energy conservation
- To impart knowledge on energy efficiencies
- To analyse various economic aspects
- To have a wide spread knowledge on advanced topics

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Attain Knowledge on Energy Conservation Technology
CO2	Knowledge on the working principle of energy conservation
CO3	Knowledge on energy efficiencies
CO4	Ability to analyze various economic aspects
CO5	Knowledge on advanced topics

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	1
CO3	2	1	2
CO4	2	2	2
CO5	2	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE2	Course Name: ENERGY CONSERVATION TECHNIQUES	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9

Historical uses–Components of the energy conservation system – Power output from an ideal system – Power output from practical system

UNIT II ENERGY CONSERVATION 9

Principle of energy conservation - waste heat recovery - Heat pump – Economics of energy conservation, cogeneration, combined cycle plants, electrical energy conservation opportunities

UNIT III ENERGY EFFICIENCIES 9

Efficiencies- Rate Processes in Energy Conversion- Energy Conversion Reactions- Energy Conversion Devices and Their Efficiency- Heat Transfer Devices and Their Efficiency- Deviations from the Ideal and Component Efficiencies

UNIT IV ECONOMIC ASPECTS 9

Economics of power factor improvement – power capacitors – power quality. Importance of electrical energy conservation – methods – energy efficient equipments. Introduction to energy auditing.

UNIT V ADVANCED TOPICS 9

Introduction to energy auditing- Other conversion technologies- Modeling of micro-grids and distributed generation system- Energy source and energy yield of wind turbine generators- Interfacing issues of renewable energy system to conventional power grid

Total No. of Periods: 45

TEXT BOOKS

1. Manwell, J.F. Mcgowan, J.G. Rogers, A.L. (2002) Wind Energy Explained – Theory, Design & Application. John Wiley & Sons
2. Gray L. Johnson, (1985) Wind Energy Systems. Prentice Hall Inc

REFERENCE BOOKS

1. Epenshaw Taylor, (2009) Utilization of Electric Energy. 12th Impression. Universities Press
2. Wadhwa, C.L. (2003) Generation, Distribution and Utilization of Electrical Energy. New Age International Pvt. Ltd.

Course Code: EBEE22OE3	Course Name: ELECTRIC VEHICLE TECHNOLOGY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To study about Electric Vehicle Technology
- To study the concept of Micro grid and the control modes
- To impart knowledge on Distributed Generation
- To analyse the impact of Grid Integration.
- To understand various power quality issues and the protection schemes for Micro grid.

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Understanding of various conventional and Nonconventional source of energy resources
CO2	Familiar to Electric Vehicles and the control modes
CO3	knowledge on Hybrid Vehicle
CO4	Familiar to Grid Integration
CO5	Acquire knowledge on various power quality issues and the protection schemes in Electric Vehicle

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE3	Course Name: ELECTRIC VEHICLE TECHNOLOGY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I: Introduction **9**

Advanced Energy Storage Systems - Types of PEVs - Charging Techniques - V2G and G2V - Alternative Fuel and HEV Vehicle Technology

UNIT II: Automotive Systems **9**

Introduction to today's automobiles – Basic Automotive Components - A working knowledge of basic automotive components - general maintenance necessary for vehicle operations f

UNIT III: Electric & Hybrid Vehicle Technology 1 **9**

Fundamentals of Electric and Gas-Electric Hybrid Vehicles - EV and HEV batteries, Fuel Cells, Electric Motor Controllers Invertors - Auxiliary Accessories

UNIT IV: Electric & Hybrid Vehicle Technology 2 **9**

Battery Electric Vehicles (BEV) - Hybrid Electric Vehicles (HEV) - Plug-in Hybrid Electric Vehicles (PHEV) – Trouble Shooting PHEV Technologies

UNIT V: EV Data Acquisition & Control Systems **9**

Vehicle Network Theory, Vehicle Embedded Controllers - Communications Protocols - Sensors, Actuators – Internal Combustion in Electric Assist Vehicles - Vehicle Emissions - Emission Control Systems - Power Control

Total No. of Periods: 45

REFERENCE BOOKS

1. Sumedha Raja karuna, Farhad Shahnia, Arindham Ghosh, "Plug-in-Electric Vehicles in Smart Grid – Integration Techniques", Springer, 2015
2. Sumedha Raja karuna, Farhad Shahnia, Arindham Ghosh "Plug-in-Electric Vehicles in Smart Grid – Integration Techniques – Energy Management", Springer, 2015
3. Sumedha Raja karuna, Farhad Shahnia, Arindham Ghosh, "Plug-in-Electric Vehicles in Smart Grid – Charging Strategies", Springer, 2015

Course Code: EBEE22OE4	Course Name: BIOMEDICAL INSTRUMENTATION	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- The student will study about communication mechanics in a biomedical system with few examples
- The student will acquire basic knowledge in life assisting and therapeutic devices

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	The graduate is capable of knowing the human physiology.
CO2	The graduate will be able to study about communication mechanics in a biomedical system with few examples
CO3	Understands the basic principles in imaging techniques
CO4	Acquires basic knowledge in life assisting and therapeutic devices
CO5	Familiar with Bio medical instruments

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE4	Course Name: BIOMEDICAL INSTRUMENTATION	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I: Anatomy, Physiology and Transducers **9 hours**

Brief review of human physiology and anatomy – cell and their structures – electrical mechanical and chemical activities – action and resting potential – different types of electrodes – sensors used in biomedicine – selection criteria for transducers and electrodes – necessity for low noise pre- amplifiers– difference amplifiers – chopper amplifiers – electrical safety – grounding and isolation

UNIT II: Electro – Physiological Measurement **9**

ECG – EEG – EMG– lead system and recording methods – typical waveforms

UNIT III: Non – Electrical Parameter Measurements **9 hours**

Measurement of blood pressure – blood flow cardiac output – cardiac rate – heart sound – measurement of gas volume – flow rate of CO_2 and O_2 in exhaust air – PH of blood

UNIT IV: Medical Imaging Parameter Measurements **9 hours**

X-RAY machine – computer tomography – magnetic resonance imaging system – ultra sonography – endoscopy – different types of telemetry system – laser in biomedicine.

UNIT V: Assisting and Therapeutic Devices **9**

Cardiac pacemakers – defibrillators ventilators – muscle stimulators – diathermy – introduction to artificial kidney artificial heart – heart lung machine – limb prosthetics– elements of audio and visual aids.

Total No. of Periods: 45

TEXT BOOKS

1. Webster, J.G. (1999) Medical Instrumentation: Application and Design.3rd Ed. John Wiley and Son.
2. Khandpur R.S. (1987) Hand book of Biomedical Instrumentation and Measurements. New Delhi: Tata McGraw-Hill.

REFERENCES

1. Geddes and Baker, (1975) Principles of Applied Biomedical Instrumentation. USA: John Wiley and Sons.
2. Well, G. (1980) Biomedical Instrumentation and Measurements. New Jersey: Prentice Hall.
3. Koryla, J. (1980) Medical and Biological Application of electro chemical devices. Chichester: John Wiley and Sons.
4. Wise, D. L. (1989) Applied Bio- sensors, Butterworth. USA:

Course Code: EBEE22OE5	Course Name: INDUSTRIAL INSTRUMENTATION	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To know about force, torque, velocity
- To learn the measurement of acceleration, vibration, density and viscosity
- To understand the Pressure and Temperature measurement

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Attain knowledge on Force, Torque and velocity
CO2	Ability to measure the acceleration, vibration etc
CO3	Capable to use the techniques for temperature and pressure measurement
CO4	Attain knowledge on Thermocouple and pyrometers
CO5	Ability to work in an Instrumentation Industry

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						√			

Course Code: EBEE22OE5	Course Name: INDUSTRIAL INSTRUMENTATION	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I: Measurement of Force, Torque and Velocity **9**

Electric balance – Different types of load cells – Magnets – Elastic load cells - Strain gauge load cell – Different methods of torque measurement – Strain gauge, relative regular twist – Speed measurement – Revolution counter

UNIT II: Measurement of Acceleration, Vibration, Density and Viscosity **9**

Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers – Mechanical type vibration instruments – Calibration of vibration pick-ups – Units of density, specific gravity and viscosity used in industries – Types of density meter – Viscosity terms – Saybolt viscometer – Rotameter type.

UNIT III: Pressure Measurement **9**

Units of pressure - Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor –Testing and calibration of pressure gauges – Dead weight tester.

UNIT IV: Temperature Measurement **9**

Definitions and standards – Primary and secondary fixed points – Calibration of thermometer, different types of filled in system thermometer – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement

UNIT V: Thermocouples and Pyrometers **9**

Thermocouples – Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output – Thermal block reference functions –Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers.

Total No. of Periods: 45

Text Books

1. Doebelin, E.O. (2003) Measurement Systems – Application and Design. Tata McGraw Hill publishing company.
2. Jain, R.K. (1999) Mechanical and Industrial Measurements. New Delhi: Khanna Publishers.

References

1. Patranabis, D. (1996) Principles of Industrial Instrumentation. Tata McGraw Hill Publishing Company Ltd.
2. Sawhney, A.K. and Sawhney, P. (2004) A Course on Mechanical Measurements, Instrumentation and Control Dhanpath Rai and Co.
3. Nakra, B.C. & Chaudary, B.C. Instrumentation Measurement & Analysis. Tata McGraw Hill Publishing Ltd.
4. Singh, S.K. (2003) Industrial Instrumentation and Control. Tata McGraw Hill.
5. Eckman, D.P. Industrial Instrumentation. Wiley Eastern Ltd.

Course Code: EBEE22OE6	Course Name: SOLAR ENERGY CONVERSION SYSTEM	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To study about Solar Radiation and the collector types
- To impart knowledge on the Application of Solar thermal Technology
- To understand the fundamentals of Solar Photovoltaic cells
- To design the Solar cells in cost effective manner.
- To learn about the solar passive Architecture

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Students understand Solar Radiation and the collector types
CO2	Acquire knowledge on the Application of Solar thermal Technology
CO3	Understand the fundamentals of Solar Photovoltaic cells
CO4	Familiar to design the Solar cells in cost effective manner
CO5	Incorporate the knowledge about the solar passive Architecture

Mapping of Course Outcome with Program Outcome (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	2	2	2	3	2
CO2	3	3	3	3	3	3	3	2	2	2	3	2
CO3	3	3	3	3	3	3	3	2	2	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2	3	2
CO5	3	3	3	3	3	3	3	2	2	2	3	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE6	Course Name: SOLAR ENERGY CONVERSION SYSTEM	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I SOLAR RADIATION AND COLLECTORS **9**

Solar Radiation- Solar angles - Sun path diagrams - shadow determination – Solar Collectors - flat plate collector thermal analysis - heat capacity effect - testing methods-evacuated tubular collectors - concentrator collectors

UNIT II APPLICATIONS OF SOLAR THERMAL TECHNOLOGY **9**

Principle of working, types - design and operation of - solar heating and cooling systems - solar water heaters – thermal storage systems – solar still – solar cooker – domestic, community – solar pond – solar drying

UNIT III SOLAR PV FUNDAMENTALS **9**

Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells

UNIT IV SOLAR PHOTOVOLTAIC SYSTEM DESIGN AND APPLICATIONS **9**

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization -voltage regulation - maximum tracking – use of computers in array design - quick sizing method - array protection and troubleshooting - stand alone

UNIT V SOLAR PASSIVE ARCHITECTURE **9**

Thermal comfort - heat transmission in buildings- bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – energy efficient landscape design

Total No. of Periods: 45

Text Books:

1. Sukhatme S P, (1984), Solar Energy, Tata McGraw Hill
2. Kreider, J.F. and Frank Kreith, (1981), Solar Energy Handbook, McGraw Hill
3. Goswami, D.Y., Kreider, J. F. and & Francis., (2000), Principles of Solar Engineering

Reference Books:

1. Garg H P., Prakash J., (2000), Solar Energy: Fundamentals & Applications, Tata McGraw Hill
2. Duffie, J. A. and Beckman, W. A., (1991), Solar Engineering of Thermal Processes, John Wiley
3. Alan L Fahrenbruch and Richard H Bube, (1983), Fundamentals of Solar Cells: PV Solar Energy Conversion, Academic Press
4. Larry D Partain, (1995), Solar Cells and their Applications, John Wiley and Sons, Inc.

Course Code: EBEE22OE7	Course Name: WIND ENERGY CONVERSION SYSTEM	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To know the basics of Wind Energy Conversion System
- To solve the Energy crisis.
- To know the Power Electronic Devices and its characteristics.
- To understand different converters
- To design wind Energy conversion system such as subsystems and its components

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Knowledge on Wind Energy Systems
CO2	Capability to find solution for Energy Crisis
CO3	Attained knowledge on various types of converters
CO4	Familiarity in Power Electronics Devices and its performance.
CO5	Ability to design Electrical Machines for Wind Energy Conversion System

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	1	3	2
CO3	1	2	3
CO4	2	2	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE7	Course Name: WIND ENERGY CONVERSION SYSTEM	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO WIND SYSTEMS **9**

Historical uses of wind – History of wind turbines – Horizontal axis wind turbines – Darreius Wind Turbines – Innovative wind turbines – Components of the wind energy conversion system – Power output from an ideal wind turbine – Power output from practical wind turbines

UNIT II WIND CHARACTERISTICS & MEASUREMENTS **9**

Meteorology of wind – Wind speed statistics – Weibull Statistics – Rayleigh and normal distribution – Wind measurements – Eolian features – Biological Indicators – Types of anemometers and their operation – Wind direction – Wind measurements with balloons

UNIT III WIND TURBINE SUBSYSTEMS & COMPONENTS **9**

Rotor – Blades – Aerodynamic design – Structural Design – Fabrication – Aerodynamic Control Surfaces – Hub – Types- Drive Train – Coupling – Gearbox – Brake – Types – Main frame & Nacelle – Tower

UNIT IV ELECTRICAL MACHINES FOR WECS **9**

Induction Machine – Theory of IM operation - Dynamic dq Modeling - Doubly fed Induction Generator – Synchronous Machines – Theory of operation – Starting wind turbines with IG - Variable Reluctance Machine – Effect of Harmonics

UNIT V OVERVIEW OF CONVERTERS **9**

Six Pulse Converter – 12 Pulse Converter – Sequential control of converters – Converter Control – EMI and Power Quality Problems – Control of Cycloconverter – Matrix Converters – High Frequency Cycloconverter, VFC and CFC

Total No. of Periods: 45

TEXT BOOKS

1. Manwell, J.F. Mcgowan, J.G. Rogers, A.L. (2002) Wind Energy Explained – Theory, Design & Application. John Wiley & Sons
2. Gray L. Johnson, (1985) Wind Energy Systems. Prentice Hall Inc
3. Bose, B.K. (2001) Modern Power Electronics & AC Drives. Prentice Hall

REFERENCE BOOKS

1. Vaughn Nelson, (2009) Wind Energy – Renewable Energy & the Environment. CRC Press

Course Code: EBEE22OE8	Course Name: ENERGY STORAGE TECHNOLOGY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To study about the Energy Storage Technology
- To know the working Principle of Batteries and its types
- To impart knowledge on Fuel Cells along with its advantage and disadvantages
- To analyse various types of energy storage devices.
- To have a wide spread knowledge on Electric Vehicle

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Attain Knowledge on Energy Storage Technology
CO2	Knowledge on the working principle of batteries and its types
CO3	Knowledge n Fuel cells
CO4	Ability to analyze various types of energy storage devices
CO5	Knowledge on Electric vehicles

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	1
CO3	2	1	2
CO4	2	2	2
CO5	2	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE8	Course Name: ENERGY STORAGE TECHNOLOGY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO ENERGY STORAGE 9

Energy storage – Utilization of Energy storage devices - Need for Energy Storage – Types of energy Storage – Comparison of Energy Storage technologies – Applications.

UNIT II ELECTRICAL ENERGY STORAGE 9

Concept of batteries – Measurement of Battery performance – Charging and Discharging- Storage Density – Safety issues. Types of Batteries – Lead Acid, Nickel-Cadmium, Zinc manganese dioxide and modern batteries- Zinc Air, Nickel Hydride, lithium battery.

UNIT III FUEL CELL 9

Fuel Cell – History of fuel cell – Principle of electrochemical Storage – Types – Hydrogen oxygen cells, Hydrogen air cell – Hydrocarbon air cell –alkaline fuel cell – detailed analysis – advantage and drawback of each cell.

UNIT IV ALTERNATE ENERGY STORAGE TECHNOLOGIES 9

Solar Photovoltaics – Wind Power - Flywheel – Super Capacitors – Principles & applications, Compressed Air Energy Storage- Concept of Hybrid Storage - Applications

UNIT V ELECTRIC VEHICLE 9

Electric Vehicle – Types – Hybrid Vehicle – Battering Charging – Usage of batteries in Hybrid vehicle – Fundamentals of Electric vehicle modeling - EV and the Environment – Pollution effect.

Total No. of Periods: 45

TEXT BOOKS

1. Ibrabim Dincer, Marc A,Rosen, (2011) Thermal Energy Storage Systems and Applications, 2nd Ed, John Wiley
2. James Larminie, John Lowry (2003), Electric Vehicle Technology Explained, John Wiley & Sons

REFERENCES

1. Seth Leitman, Bob Brant (2013) Build Your Own Electric Vehicle, 3rd Ed, McGraw Hill
2. James Larminie, Andrew Dicks, (2003), Fuel Cell Systems Explained, Wiley

Course Code: EBEE22OE9	Course Name: ELECTRICAL MACHINES	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To acquires basic knowledge in DC Machine
- Able to study about Transformer, types and its applications.
- To understand the basic principles of AC Machines.
- To acquire basic knowledge about stepper motors and SRM.
- To acquire basic knowledge in PMDC and PMSM

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Acquires basic knowledge in DC Machine
CO2	The graduate will be able to study about Transformer .
CO3	Understands the basic principles in AC Machines**.**
CO4	Acquires basic knowledge about stepper motors and SRM.
CO5	Acquires basic knowledge in PMDC and PMSM

Mapping of Course Outcome with Program Outcome (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**
CO4	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**

COs /PSOs	PSO1	PSO2	PSO3
CO1	**2**	**3**	**1**
CO2	**2**	**3**	**1**
CO3	**2**	**3**	**1**
CO4	**2**	**3**	**1**
CO5	**1**	**3**	**1**

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OE9	Course Name: ELECTRICAL MACHINES	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I: DC MACHINES **9**

Construction details of DC machines – principle of operation of DC generator – EMF equation – Characteristics of DC generators – Principle of DC motor –Back EMF – Torque equation – Characteristics shunt, series and compound motors - Losses and efficiency – Starters – Speed control – applications.

UNIT II: TRANSFORMERS **9**

Principle of ideal transformer – constructional details – EMF equation – Equivalent circuit – Voltage regulation – losses and efficiency – OC and SC tests on transformer – Autotransformer – Power supplies - basic principle of SMPS and UPS.

UNIT III: SYNCHRONOUS MACHINES AND INDUCTION MOTORS **9**

Construction details – principle of alternator – EMF equation – Voltage regulation -Starting of synchronous motor.

Induction motor – principle of operation – torque equation – torque-slip characteristics – Starting methods and speed control.

UNIT-IV: STEPPER MOTORS AND SRM **9**

Stepper Motor -Constructional features –Principle of operation –Types – Torque predictions – performance Characteristics of Stepper Motor – Applications.

SRM Constructional features –Principle of operation- Torque prediction– performance Characteristics – Applications**.**

UNIT-V PMDC AND PMSM **9**

Permanent magnet brushless DC motor -Fundamentals of Permanent Magnets- Types- Principle of operation- EMF and Torque equations - performance Characteristics of PMDC - Applications.

Permanent magnet synchronous motor- Constructional features -Principle of operation – EMF and Torque equations – performance characteristics - Applications.

Total No. of Periods: 45

TEXT BOOKS

1**.** B.L.Theraja “A Textbook of Electrical Technology - Volume II” S. Chand Publishing, 2017
2. S.K Bhattacharya, “Electrical Machines”, Tata Mc Graw Hill Publications. 2015.
3. E.G. Janardanan,” Special Machines “, PHI Learning Private limited. -2014

REFERENCE BOOKS

1. I.J. Nagrath & D.P. Kothari, “Electrical Machines”, TMH Publications.

Course Code: EBEE22OL1	Course Name: TRANSDUCER LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To learn practically about transducers and about the types of Transducers
- To study various transducers used for the measurement of various physical Quantities
- To identify suitable instruments to meet the requirements of industrial applications
- To measure Resistive, Capacitive and Inductive transducers
- To calibrate various transducers

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Enables the students to practically know about transducers and about the types of Transducers
CO2	various transducers used for the measurement of various physical Quantities
CO3	The student can identify suitable instruments to meet the requirements of industrial applications
CO4	The graduate can measure Resistive, Capacitive and Inductive transducers
CO5	Graduate can calibrate various transducers

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	3
CO3	2	3	3
CO4	3	3	2
CO5	2	2	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OL1	Course Name: TRANSDUCER LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a Potentiometric transducer.
2. Strain gauge characteristics.
3. Load cell characteristics.
4. Photoelectric tachometer.
5. Hall effect transducer.
6. Characteristics of LVDT.
7. Characteristic of LDR, Thermistor and thermocouple.
8. Ramp response characteristic of filled in system thermometer.
9. Step response characteristic of RTD and thermocouple.
10. Flapper nozzle system.
11. P/I and I/P converters.
12. Study of smart transducers

Total No. of Periods: 45

Course Code EBEE22OL2	Course Name: PLC & SCADA LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To understand the programming in PLC.
- The students will be able to understand various faults using SCADA.

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Acquire programming knowledge in PLC
CO2	Student can understand various faults using SCADA

Mapping of Course Outcome with Program Outcome (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	1	3	1	3	1
CO2	3	3	3	3	3	3	2	1	3	1	3	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code EBEE22OL2	Course Name: PLC & SCADA LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. a) Interfacing of lamp and button with PLC for ON/OFF operation.
   b) Perform Delayed Operation of Lamp by Using Push Button.
2. a) Multiple push button operation with delayed lamp for ON/OFF operation.
   b) Combination of Counter & Timer for Lamp ON/OFF operation
3. To study Set and Reset operation of lamp.
4. DOL Starter & Star Delta Starter operation by using PLC.
5. PLC based temperature sensing using RTD.
6. PLC based thermal ON/OFF control.
7. PLC interfaced with SCADA and status read/ command transfer operation.
8. Parameter reading of PLC in SCADA.
9. Alarm annunciation using SCADA.
10. Reporting and Trending in SCADA System.
11. Temperature sensing using SCADA
12. Pressure sensing using SCADA

Total No. of Periods: 45

Course Code: EBEE22OL3	Course Name: ELECTRICAL MAINTENANCE LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To acquire knowledge on Electrical Wiring
- To know about energy meter
- To study about the Insulators
- To know about the Neutral and Earthing
- To learn about the Distribution Transformers

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Capable of designing a Electrical wiring circuit for Residence.
CO2	Acquired knowledge o how to calibrate Energy meter
CO3	Knowledge on Insulators and its types
CO4	Ability to calculate the earthing of a particular area
CO5	Familiarity in Distribution Transformers

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	1	2
CO3	3	2	1
CO4	1	2	3
CO5	1	2	1

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OL3	Course Name: ELECTRICAL MAINTENANCE LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Residential House Wiring Using switches, Fuse, Indicator, Lamp and Energy Meter
2. Types of Wiring
3. Study Troubleshooting of Electrical Equipment
4. To study earthing of electrical installation.
5. To study types of insulators.
6. To study maintenance schedule for distribution transformer, testing, maintenance and protection of distribution transformer.
7. To study of measurement of insulation resistance and capacitance.
8. To study of maintenance schedule for storage battery switchgear and control equipment.
9. To study fault occurring in an induction motor to troubleshoot them.
10. To study the types of neutral earthing and substation earthing.
11. To study construction and types of earthing.
12. Calibration of Energy meter

Total No. of Periods: 45

Course Code: EBEE22OL4	Course Name: POWER ELECTRONICS LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To obtain an overview of different types of power semiconductor devices and their switching characteristics with different triggering methods.
- To understand the operation, characteristics and performance parameters of controlled Rectifiers and Inverters.
- To understand the techniques to control the speed of Brushless DC Motor and SR Motor
- To understand the operation of AC Voltage Controllers
- To understand the applications of Power Electronic devices and Electric drives in Power System

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Students will understand the operation of power electronics devices and gain knowledge of the comparative study of different devices based on their switching characteristics .
CO2	Students will understand the operation , characteristics and performance parameters of controlled Rectifiers and Inverters
CO3	Students capable to understand the techniques to control the speed of Brushless DC Motor and SR Motor
CO4	Students able to understand the operation of AC Voltage Controllers
CO5	Students able to understand the operation of different converters and incorporate in designing the HVDC transmission System

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	1	2
CO3	3	2	1
CO4	1	2	3
CO5	1	2	1

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						√			

Course Code: EBEE22OL4	Course Name: POWER ELECTRONICS LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. SCR Triggering Circuits.
2. Phase control using TRIAC
3. Phase control using SCR.
4. Characteristics of SCR.
5. Characteristics of IGBT.
6. Single phase converters.
7. Parallel Inverters.
8. Series inverters.
9. IGBT based PWM Inverters with filters.
10. IGBT based PWM Inverters without filters.
11. Step up Chopper.
12. Step Down Choppers.

Total No. of Periods: 45

Course Code: EBEE22OL5	Course Name: BIOMEDICAL INSTRUMENTATION LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- Study of Biological Preamplifiers.
- To learn Recording of ECG signal and Analysis.
- To learn Recording of Audiogram.
- To study Recording of EMG
- To study the safety aspects of surgical diathermy

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Understands Biological Preamplifiers.
CO2	Capable of Recording of ECG signal and Analysis.
CO3	Capable of Recording of Audiogram.
CO4	Capable of Recording of EMG
CO5	Understands Biological Preamplifiers.

Mapping of Course Outcome with Program Outcome (POs)

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

COs /PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	3
CO3	2	3	3
CO4	3	3	2
CO5	2	2	3

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						✓			

Course Code: EBEE22OL5	Course Name: BIOMEDICAL INSTRUMENTATION LABORATORY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

11. Study of Biological Preamplifiers.
2. Recording of ECG signal and Analysis.
3. Recording of Audiogram.
4. Recording of EMG, EEG
5. Recording of various physiological parameters using patient monitoring system and telemetry units.
6. Measurement of pH, pO2 and conductivity.
7. Study and analysis of functioning and safety aspects of surgical diathermy.
8. Acquisition of Heart sounds using PCG
9. Biotelemetry system
10. BP measuring techniques
11. Glucose sensor
12. Heart Lung machine model – study

Total No. of Periods: 45

Course Code: EBEE22OL6	Course Name: ELECTRICAL MACHINES LAB	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES

- To Study various types of DC machines and Transformers which mainly covers experiments with real machines and students gain practical experience in using various DC machines, transformers, starters etc.
- Various types of experiments related to Electrical machinery like Load characteristics, Load test, Brake test, Parallel Operation, Loss separation, OC and SC characteristics are done in this Lab.
- To study the characteristics of Alternator, induction motors.

COURSE OUTCOMES(Cos)

Students completing this course were able to

CO1	Various types of DC machines and Transformers which mainly covers experiments with real machines and Students gain practical experience in using various DC machines
CO2	Various types of experiments related to Electrical machinery like Load characteristics
CO3	To study the characteristics of Transformers.
CO4	To study the characteristics of Alternator.
CO5	To study the characteristics of induction motors.

Mapping of Course Outcome with Program Outcome (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**2**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO2		**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO3		**3**	**3**	**3**	**1**	**3**	**2**	**2**	**3**	**2**	**3**	**3**
CO4		**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO5		**3**	**3**	**3**	**1**	**3**	**2**	**2**	**3**	**2**	**3**	**3**

COs /PSOs	PSO1	PSO2	PSO3
CO1	**2**	**1**	**2**
CO2	**2**	**1**	**2**
CO3	**2**	**1**	**2**
CO4	**2**	**1**	**2**
CO5	**2**	**1**	**2**

3/2/1 Indicates Strength of Correlation, 3–High, 2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill Component	Practical / Project
						√			

Course Code: EBEE22OL6	Course Name: ELECTRICAL MACHINES LAB	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Open Circuit and Load Test on DC Shunt Generator
2. Load Test on DC Shunt Motor.
3. Load Test on DC Series Motor.
4. Swinburne's Test
5. Speed Control on DC Shunt Motor.
6. O.C. and S.C. test on Single -phase Transformer
7. Load Test on Single phase Transformer
8. Load Test on Alternator.
9. Load Test on Single -Phase Induction Motor.
10. Load Test on Three -Phase Induction Motor.

Total No. of Periods: 45