



Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
DEEMED TO BE UNIVERSITY



(An ISO 9001:2015 Certified Institution)

University with Graded Autonomy Status

Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu. India.

Dr. M.G.R Educational and Research Institute

Department of EEE

B. Tech - Bio Medical Instrumentation Engineering

Curriculum – 2018 Regulation BMI

ELECTIVE - I							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E01	Bio Control System	Ty	3	0/0	0/0	3
2	BBI18E02	Rehabilitation Engineering	Ty	3	0/0	0/0	3
3	BBI18E03	Biomaterials and Implantable Devices	Ty	3	0/0	0/0	3
4	BEI18E05	Embedded System	Ty	3	0/0	0/0	3

ELECTIVE -II							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E04	Laser and Ultrasonic Application in Medicine	Ty	3	0/0	0/0	3
2	BBI18E05	Computer based Medical Instrumentation	Ty	3	0/0	0/0	3
3	BBI18E06	Biomedical MEMS and Nano Technology	Ty	3	0/0	0/0	3
4	BBI18E07	Computer Networks	Ty	3	0/0	0/0	3

ELECTIVE –III							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E08	Neuroscience for Biomedical Applications	Ty	3	0/0	0/0	3
2	BBI18E09	Biological Effects of Radiation	Ty	3	0/0	0/0	3
3	BBI18E10	Drug Delivery Systems	Ty	3	0/0	0/0	3
4	BEI18E12	Artificial Intelligence and Expert Systems	Ty	3	0/0	0/0	3



C. B. Palaniappan

REGISTRAR
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Maduravoyal, Chennai 600 095



ELECTIVE –IV							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E11	Medical Informatics	Ty	3	0/0	0/0	3
2	BEI18E16	Principles of Robotics	Ty	3	0/0	0/0	3
3	BBI18E12	Biomedical Signal processing	Ty	3	0/0	0/0	3
4	BBI18E13	Bio-Materials and Artificial Organs	Ty	3	0/0	0/0	3
ELECTIVE –V							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E14	Recent Advances Applied to Hospital Engineering	Ty	3	0/0	0/0	3
2	BBI18E15	Hospital Management	Ty	3	0/0	0/0	3
3	BBI18E16	System Theory Applied to Biomedical Engineering	Ty	3	0/0	0/0	3
4	BBI18E17	Special Transducer and Instrumentation	Ty	3	0/0	0/0	3



OPEN ELECTIVE

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BEE18OE1	Electrical Safety for Engineers	Ty	3	0/0	0/0	3
2	BEE18OE2	Energy Conservation Techniques	Ty	3	0/0	0/0	3
3	BEE18OE3	Electric Vehicle Technology	Ty	3	0/0	0/0	3
4	BEE18OE4	Biomedical Instrumentation	Ty	3	0/0	0/0	3
5	BEE18OE5	Introduction to Power Electronics	Ty	3	0/0	0/0	3
6	BEE18OE6	Industrial Instrumentation	Ty	3	0/0	0/0	3
7	BEE18OE7	Solar Energy Conversion System	Ty	3	0/0	0/0	3
8	BEE18OE8	Wind Energy Conversion System	Ty	3	0/0	0/0	3
9	BEE18OE9	Energy Storage Technology	Ty	3	0/0	0/0	3
OPEN LAB							
1	BEE18OL1	Transducer LAB	Lb	0	0/0	3/0	1
2	BEE18OL2	PLC and SCADA LAB	Lb	0	0/0	3/0	1
3	BEE18OL3	Electrical Maintenance LAB	Lb	0	0/0	3/0	1
4	BEE18OL4	Power Electronics LAB	Lb	0	0/0	3/0	1
5	BEE18OL5	Bio Medical Instrumentation LAB	Lb	0	0/0	3/0	1



Subject Code: BBI18E01	Subject Name : BIO CONTROL SYSTEM	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 strong foundation in basic science and mathematics necessary to formulate, solve and analyze control and instrumentation problems
- To solve control and instrumentation problems
- To analyze control and instrumentation problems
- To understand and apply differential equation, integrals, matrix theory, probability theory etc
- To provide good knowledge of instrumentation systems and their applications

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands strong foundation in basic science and mathematics necessary to formulate, solve and analyze control and instrumentation problems
CO2	Capable to solve control and instrumentation problems
CO3	Capable to analyze control and instrumentation problems
CO4	Understands and applies differential equation, integrals, matrix theory, probability theory etc
CO5	Familiarized with good knowledge of instrumentation systems and their applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	L	M	H	L	H	M
CO2	M	H	L	M	H	L	M	H	L	M	H	M
CO3	H	M	L	H	M	L	H	M	L	H	M	L
CO4	M	H	M	L	M	H	L	M	H	L	M	H
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	H	M	L	H	M
CO3	M	H	M	H	L
CO4	H	M	L	M	M
CO5	H	M	L	M	H

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
						✓			



BBI18E01 **BIO CONTROL SYSTEM** **3** **0/0** **0/0** **3**

UNIT I **CONTROL SYSTEM MODELING** **9**

System concept- Differential Equations- Transfer functions- modeling of electrical systems- Translational and rotational mechanical systems-physiological systems- block diagram modeling- signal flow graphs

UNIT II **TIME RESPONSE ANALYSIS** **9**

Time domain specifications - step and Impulse response analysis of first order and second order systems- steady state errors- Root locus techniques- construction of root locus- dominant poles- applications of Root locus diagram

UNIT III **FREQUENCY RESPONSE & STABILITY ANALYSIS** **9**

Frequency response- Bode plot-Nyquist plots- Nyquist stability criterion- Relative stability- Gain margin- phase margin- bandwidth magnitude plots- constant circles- Nichol's chart –stability –Routh-Hurwitz criteria

UNIT IV **PHYSIOLOGICAL CONTROL SYSTEMS** **9**

Introduction to physiological control systems- modeling of human movements- parameter estimation- linearizing

UNIT V **STUDY OF BIOLOGICAL SYSTEMS** **9**

Human Thermal system- Neuro muscular system- Respiratory system- oculomotor system

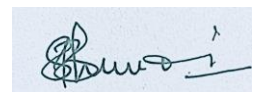
Total No of Periods: 45

TEXT BOOKS:

1. M.Gopal, “Control Systems”, Principles and Design, Tata McGraw-Hill, 1997
2. Benjamin. C.Kuo, “Automatic Control Systems”, Prentice Hall of India, 1995

REFERENCE BOOKS:

1. Manfrecllyner and John H.Milsum, “Bio Medical engineering system”, McGraw-Hill and Co., New York, 1970





Subject Code: BBI18E02	Subject Name : REHABILITATION ENGINEERING	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 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)

CO1	Understands the basics of Rehabilitation Engineering
CO2	Capable to design Wheel Chairs
CO3	Understands the recent developments in the field of rehabilitation engineering
CO4	Acquires various assistive technology for vision and hearing
CO5	Analysis various orthotic and prosthetic devices

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	L	M	H	L	M	H	H	H
CO2	H	M	H	M	L	M	H	L	M	H	L	M
CO3	H	M	H	M	L	M	H	H	M	H	L	M
CO4	L	H	M	L	H	M	H	L	L	H	M	H
CO5	M	H	L	H	M	L	H	L	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	L	H	M	H
CO3	H	L	M	H	L
CO4	L	M	M	L	M
CO5	H	M	L	H	M

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
					✓				



BBI18E02 **REHABILITATION ENGINEERING** **3** **0/0** **0/0** **3**

UNIT I REHABILITATION TECHNOLOGY 9

Selection -design and manufacturing of augmentive- assistive devices appropriate for individual with disability

UNIT II REHABILITATION SCIENCE 9

Knowledge about the basic and clinical research - the variation in the physiological functioning - anatomical structure

UNIT III REHABILITATION ADVOCACY 9

Legal aspect helps the handicapped people in choosing the devices -the provisions available to them in this regard

UNIT IV REHABILITATION MEDICINE 9

Physiological aspects of functional recovery -neurological and physiological aspects -rehabilitation therapies training to restore vision auditory and speech

UNIT V 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

Total No of Periods: 45

TEXT BOOKS:

1. Reswick.J., “What is Rehabilitation Engineering?, Annual Review of rehabilitation”,volume 2
springer – verlag, New York, 1982

REFERENCE BOOKS:

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



Subject Code: BBI18E03	Subject Name : BIOMATERIALS AND IMPLANTABLE DEVICES	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMEDICAL INSTRUMENTATION	T	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 :

- Learn characteristics and classification of Biomaterials
- Understand different metals and ceramics used as biomaterials
- Learn polymeric materials and combinations that could be used as a tissue replacement implants
- Know the various artificial organs developed using these materials to perform medical application.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze different types of Biomaterials and its classification.
CO2	Perform combinations of materials that could be used as a tissue replacement implant.
CO3	Know about the various polymeric materials used for medical applications
CO4	About bio-ceramics and its applications in medicine
CO5	The graduate will be capable to perform medical application.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	H	M	H	L	L	M
CO2	M	M	H	M	L	H	M	L	H	M	L	H
CO3	H	H	H	M	H	M	H	L	H	M	H	M
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	L	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	L	H
CO2	H	M	H	M	L
CO3	M	M	L	H	M
CO4	H	L	M	H	L
CO5	L	M	M	H	M

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
					✓				



UNIT I BIOCOMPATIBILITY AND HEMOCOMPATIBILITY 9

Overview of Biomaterials used as medical devices - Classification of biomaterials - Impact and future of biomaterials - performance of implants - Interfacial phenomena and tissue response to biomaterials - Metals and alloys for orthopedic implants- Stainless steel - Cobalt chromium alloy - Titanium and its alloys - Electro kinetic factors - Types of orthopedic fixation devices – pins - screws and plates - IM nails and spinal

UNIT II BIOELECTRIC EFFECT 9

Wolff's law - Interface problems with artificial joints and various fixation methods - Failure of implantation materials- metallic corrosion - wear - metallic implant fractures and their impact on biological systems - Hard tissue replacements- total hip and knee joint replacements

UNIT III POLYMERS IN BIOMEDICAL USE 9

Hydrogels- silicone rubber- biodegradable polymers- microorganisms in polymeric implants and polymer sterilization-Biopolymers- Synthetic polymers- Composites- Types and Applications- Contraceptive devices

UNIT IV ORTHOPAEDIC IMPLANTS 9

Ophthalmology - introduction - contact lenses - eye shields and artificial tears- Biological Tests-Material surface characterization – Corrosion- Standards on biomaterials

UNIT V BIOCERAMICS, TYPES 9

Bioactive- resorbable - non-resorbable -Stoichiometry and Ca/P ratio of various forms calcium phosphates -bio ceramic coatings on metallic implants and bone bonding reactions on implantation - Hydroxyapatite - properties and applications - Bone cements and bio glasses- Dental implants – materials - types and designs

Total No of Periods: 45

TEXT BOOKS:

1. Sujata V Bhat., "Biomaterials", Narosa Publishing House, New Delhi, 2002
2. A.F. Von Recum, "Handbook of Biomaterials Evaluation - Scientific, Technical and Clinical Testing of Implant Materials", 2nd Edn., Taylor & Francis, Philadelphia, 1999
3. F. Silver and C. Dillon, "Biocompatibility: Interactions of Biological and Implantable Materials" Vol.1, VCH Publishers, New York, 1989. 4. Park. J.B. "Biomaterials: An Introduction", CBS Publishers, 2007

REFERENCE BOOKS:

1. L.L. Hench and E.C. Ethridge "Biomaterials: An Interfacial Approach", Academic press, New York, 1982.
2. F.H. Silver, "Biomaterials, Medical Devices and Tissue Engineering: An Intergrated Approach", 1st Editionn, Chapman & Hall, London, 1994
3. Buddy Ratner etal., "Biomaterials Science – An Introduction to Materials in Medicine", Academic Press, San Diego, 2004



Subject Code: BEI18E05	Subject Name : EMBEDDED SYSTEM	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: ADVANCEMENT IN ELECTRONICS	T	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 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)

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	M	H	M	H	M	L	H	M	H	L	L	M
CO2	M	M	H	M	L	H	M	L	H	M	L	H
CO3	H	H	H	M	H	M	H	L	H	M	H	M
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	L	H	M	L	H	M
COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5							
CO1	M	H	M	L	H							
CO2	H	M	H	M	L							
CO3	M	M	L	H	M							
CO4	H	L	M	H	L							
CO5	L	M	M	H	M							

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			
						✓						



BEI18E05 **EMBEDDED SYSTEM** **3** **0/0** **0/0** **3**

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

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 9

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 9

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 9

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 9

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

Total No of Periods: 45

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, 1997



Subject Code: BBI18E04	Subject Name : LASER AND ULTRASONIC APPLICATION IN MEDICINE	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 of Laser
- To Study About Ultrasonic
- To Learn About Ultrasonic Scanners
- To Study About High Energy Ultrasonic
- To Gain Knowledge of Holographic Application InMedicine

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	M	H	M	L	M	H	M	L	H	M	L	M
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	H
CO5	M	L	H	H	M	L	H	M	L	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	L	H	M	L
CO3	H	M	L	M	H
CO4	M	H	L	M	H
CO5	L	M	H	M	L

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
					✓				



BBI18E04	LASER AND ULTRASONIC APPLICATION IN MEDICINE	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 -2-D 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 MEDICINE				9
Wave front Recording and Reconstruction -Recording Media -Image forming application -Motion Induced Contrast -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

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



Subject Code: BBI18E05	Subject Name : COMPUTER BASED MEDICAL INSTRUMENTATION	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMEDICAL INSTRUMENTATION	T	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 Introduction of Computer Based Medical Instrumentation
- To Study About the Microcontrollers
- To Learn About the System Design
- To Gain Knowledge on Computers in Patient Monitoring
- To Study About Medical Equipments System

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires Knowledge On Introduction of Computer Based Medical Instrumentation
CO2	Capable to analyze the concept of Microcontrollers
CO3	Capable to analyze System Design
CO4	Capable to acquire Knowledge On Computers In Patient Monitoring
CO5	Acquires Knowledge on Medical Equipments System

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	L	M	H	L	M	H
CO2	H	M	L	M	H	L	M	H	L	M	H	M
CO3	H	M	L	M	H	L	M	H	L	M	H	L
CO4	L	M	L	M	L	H	M	L	M	H	L	M
CO5	L	M	H	L	M	M	L	M	L	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	H	M	L	M	H
CO3	L	M	H	L	M
CO4	M	H	L	M	H
CO5	M	L	H	L	M

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
					✓				



BBI18E05

**COMPUTER BASED MEDICAL
INSTRUMENTATION**

3 0/0 0/0 3

UNIT I INTRODUCTION 9

8086 Architecture - system connections and timing - Instruction set and assembly language programming - Macro assemblers - BIOS and DOS Services - memory and I/O interfacing - Advanced Intel 32 bit processors

UNIT II MICROCONTROLLERS 9

Introduction - 8051 architecture and programming - micro controller based medical systems - TMS 320 series - architecture and programming - applications in bio-signal processing - IDE51 - C Cross Assemblers

UNIT III SYSTEM DESIGN 9

Multichannel computerized ECG,EMG and EEG data acquisition – storage -analysis - retrieval techniques - Medical image acquisitions through video - card - storage and retrieval techniques - Moderns and computer networking in the hospital

UNIT IV COMPUTERS IN PATIENT MONITORING 9

Physiological monitoring - automated intensive care units - computerized arrhythmia monitoring - information flow in a clinical lab - computerized concepts - interfacing to HIS

UNIT V MEDICAL EQUIPMENTS SYSTEM 9

Microprocessor based medical system - pulmonary instrumentation - anesthesia machine - EEG system - microprocessor based blood pressure monitor - prosthetic systems - bio- chemical measuring systems and microprocessor based medical devices - Radiological Information system.

Total No of Periods: 45

TEXT BOOKS:

1. Kenneth J. Ayala, "The 8051 Micro Controller – Architecture Programming and Applications", Second Edition, Penram International, 1996

REFERENCE BOOKS:

1. Douglas V. Hall, "Microprocessors and Interfacing: Programming and hardware", Mcgrase Hill, Singapore, 1999



Subject Code: BBI18E06	Subject Name :BIOMEDICAL MEMS AND NANOTECHNOLOGY	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMATERIALS & IMPLANTABLE DEVICES	T	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 BioMEMS and its application in healthcare
- To give an insight to the DNA based BioMEMS
- To study about the biomedical Nanotechnology and its application in researchdomain

COURSE OUTCOMES (COs) : (3- 5)

CO1	understands the working principle of MEMS and Microsystems
CO2	understands the working of MOEMS Technology
CO3	understands the concepts of BioMEMS and its application in healthcare
CO4	Acquires knowledge on the DNA based BioMEMS
CO5	Acquires knowledge on the biomedical Nanotechnology and its application in researchdomain

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	L	M	H	L	M	H	L	M	H
CO2	H	H	H	L	L	M	H	M	H	L	M	H
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	L	M	H	L	M	H	L	M	H	L	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	H	L	M
CO2	M	H	L	M	H
CO3	H	H	H	M	L
CO4	M	H	L	M	H
CO5	L	M	M	L	M

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
						✓			



BBI18E06

**BIOMEDICAL MEMS AND
NANOTECHNOLOGY**

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 BIOMEMS AND 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 and applications”, CRC Press, First edition, 2007

REFERENCE BOOKS:

1. Tai-Ran Hsu, “MEMS and Microsystems- Design, Manufacture and Nanoscale Engineering”, 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 Biomedical Nanotechnology”, Volume I, Springer, First Edition, 2006
4. Paul C.H. Li, “Introduction to Microfluids and BioMEMS: A Design and Problem-Solving Textbook”, CRC Press, First Edition, 2009
5. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, First Edition 2002.



Subject Code: BBI18E07	Subject Name : COMPUTER NETWORKS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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, Tokenbus
- To learn about Token ring, FDDI, Wireless LAN

COURSE OUTCOMES (COs) : (3- 5)

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	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	H	L	M	H
CO3	H	M	L	H	L
CO4	L	M	H	L	M
CO5	H	M	L	M	H

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
					✓				



BBI18E07 COMPUTER NETWORKS 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



Subject Code: BBI18E08	Subject Name: NEUROSCIENCE FOR BIOMEDICAL APPLICATIONS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 System Concept
- To Gain Knowledge on Transducer Function
- To Study About Impedance Concept
- To Learn About Periodic Signals, Feedback
- To Gain Knowledge on Simulation of Biological Systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands System Concept
CO2	Acquires knowledge on Transducer Function
CO3	Graduate understands Impedance Concept
CO4	Understands Periodic Signals, Feedback
CO5	Simulation of Biological Systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	H	L	M	H
CO3	H	M	L	H	L
CO4	L	M	H	L	M
CO5	H	M	L	M	H

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
					✓				



BBI18E08 **NEUROSCIENCE FOR BIOMEDICAL APPLICATIONS** **3** **0/0** **0/0** **3**

UNIT I INTRODUCTION TO NEUROSCIENCE **9**

An overview of neuroscience - Applications of neuroscience - Neurons and Neuroglia - Neurotransmitters

UNIT II NERVOUS SYSTEM **9**

Nervous system: central nervous system - peripheral nervous system - autonomic nervous system - anatomical organization of the nervous system - functional organization of the nervous system - neurons- the nerve cell - CSF

UNIT III ELECTRICAL PROPERTIES OF NERVOUS SYSTEM **9**

Electrolytes within our neurons - Ion channels - Local signaling - Signal propagation - Action potential – Synapse - Synaptic integration - Modulation of synaptic transmission - Nerve-Muscle interaction

UNIT IV NEURAL NETWORKS **9**

Current flow in neurons - Introduction to electro diagnostic signals and their measurement - nerve conduction study - evoked potentials and EEG

UNIT V CHALLENGES **9**

Neuroscience methods and techniques to understand the functions of nervous system - Pathology of Nervous system - Molecular and cellular mechanisms of Parkinson’s - Huntington’s - Stroke and Alzheimer’s diseases

Total No of Periods: 45

TEXT BOOKS:

1. Richard S Snell, “Clinical Neuro Anatomy”, Lippincott Williams & Wilkins, 2006
2. W.F Ganang, “Review of Medical Physiology”, Mc Graw Hill Professional, 21st Edition, 2003

REFERENCE BOOKS:

1. A Krishnamurti, “Notes on Nervous System”, Janagam Offset Printers, 1999
2. Eric R Sandel, “Principles of Neural Science”, Elsevier, 4th Edition, 2000



Subject Code: BBI18E09	Subject Name :BIOLOGICAL EFFECTS OF RADIATION	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: MEDICAL PHYSICS	T	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 Study About Actionof Radiation on Living Cells
- To Learn About Somatic Application of Radiation
- To Gain Knowledge on Genetic Effects of Radiation
- To Study About Effectof Microwave and RF With Matters
- To Gain Knowledge on UV Radiation

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands Action of Radiation on Living Cells
CO2	Capable to analyze Somatic Application of Radiation
CO3	Acquires Knowledge on Genetic Effects of Radiation
CO4	Understands Effect of Microwave and RF With Matters
CO5	Acquires Knowledge on UV Radiation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	M	L	M	H	L	M	H
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	H	M	L	H	M	H	M	H	L	M	H	L
CO4	L	M	H	L	M	H	L	M	H	L	M	H
CO5	H	M	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	H	M	H	L	H
CO3	L	M	H	L	M
CO4	H	L	M	H	M
CO5	M	L	H	L	M

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
					✓				



BBI18E09 BIOLOGICAL EFFECTS OF RADIATION 3 0/0 0/0 3

UNIT I ACTION OF RADIATION ON LIVING CELLS 9

Various theories related to radiation at cellular level -DNA and chromosomal damages -experiments on computation of various parameters related to this radiation exposure

UNIT II SOMATIC APPLICATION OF RADIATION 9

Radio sensitivity protocols of different issues of human -LA\D 50/30 effective radiation on skin -bone marrow - eye -endocrine glands - basis of radiotherapy

UNIT III GENETIC EFFECTS OF RADIATION 9

Thresholds and linear dose -gene control hereditary diseases -effect of dose and I Infleneceson genetic equilibrium

UNIT IV EFFECT OF MICROWAVE AND RF WITH MATTERS 9

Effects on various human organs and systems -wavelength in tissues -nonthermal interaction -low frequency radiation -measurement devices used to compute the thermal effects -standards of protection - national and international standards and precautions.

UNIT V UV RADIATION 9

Classification of sources-measurement -photo medicine -UV radiation safety Visibleand infrared radiation -combined effect of UV and IR -dose measuring instruments sed safety standards for this radiation

Total No of Periods: 45

TEXT BOOKS:

1. Glasser.O., "Medical Physics", vol I, II, III, The year book Publishers Inc., Chicago, 1980
2. Baranski.S and Cherski.P, "Biological effects of microwave", Hutchison and Ross Inc., Stroudsburg, 1980

REFERENCE BOOKS:

1. Moselly.H., "non-ionizing Radiation", Adam-Hilgar, Bristol, 1988



Subject Code: BBI18E10	Subject Name : DRUG DELIVERY SYSTEMS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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
- Givedirection 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)

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	H	M	L	H	H	H	M	L	H	M	H	L
CO2	M	H	M	L	H	M	L	H	M	L	H	M
CO3	H	H	M	L	H	L	M	H	L	M	H	L
CO4	L	M	H	L	H	M	L	M	H	L	M	H
CO5	H	M	L	H	L	M	H	L	M	H	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	H
CO2	M	H	L	H	M
CO3	H	H	H	M	L
CO4	M	M	H	L	M
CO5	H	H	M	L	M

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			
					✓							



BBI18E10 DRUG DELIVERY SYSTEMS 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 propellant 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



Subject Code: BEI18E12	Subject Name : ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 :

- Representing the concept of intelligent agents, search technique, knowledge, reasoning and planning.
- Providing the ideas of intelligent agents and search method.
- Learning about knowledge representation.
- Graduates to understand about planning and learning methodologies.
- Implementation of plans and method for designing controllers

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate can represent the concept of intelligent agents, search technique, knowledge, reasoning and planning.
CO2	Capable of giving ideas of intelligent agents and search method.
CO3	Understands knowledge representation
CO4	Graduates can understand about planning and learning methodologies.
CO5	Understands Implementation of plans and method for designing controllers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	H	H	M	L	H	M	H	L
CO2	M	H	M	L	H	M	L	H	M	L	H	M
CO3	H	H	M	L	H	L	M	H	L	M	H	L
CO4	L	M	H	L	H	M	L	M	H	L	M	H
CO5	H	M	L	H	L	M	H	L	M	H	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	H
CO2	M	H	L	H	M
CO3	H	H	H	M	L
CO4	M	M	H	L	M
CO5	H	H	M	L	M

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
					✓				



Subject Code: BBI18E11	Subject Name :MEDICAL INFORMATICS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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)

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	H	M	L	L	L	H	M	L	M	H	L	M
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	M	H	L	M	H	L	M	H	L	M	H	L
CO5	L	M	L	H	L	M	H	L	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	H	M	L	M	H
CO3	L	M	H	L	M
CO4	M	L	M	H	L
CO5	H	M	L	M	H

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
					✓				



BBI18E11 MEDICAL INFORMATICS 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 IV VISUAL 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



Subject Code: BEI18E16	Subject Name : PRINCIPLES OF ROBOTICS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	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)

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	M	H	M	L	H	M	H	M	L	H	M	L
CO2	H	M	L	H	L	M	H	L	M	H	L	M
CO3	H	H	M	L	H	M	L	M	L	H	M	L
CO4	M	H	M	M	H	M	L	L	H	M	L	M
CO5	M	H	M	L	M	H	L	M	H	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	M
CO2	M	L	H	M	H
CO3	L	H	M	H	M
CO4	M	H	L	M	H
CO5	M	H	L	M	M

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
					✓				



BEI18E16	PRINCIPLES OF ROBOTICS	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. McKerrow P.J., "Introduction to Robotics", Addison Wesley, USA, 1991
5. Issac Asimov, "I Robot", Ballantine Books, New York, 1986



Subject Code: BBI18E12	Subject Name :BIOMEDICAL SIGNAL PROCESSING	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 :

- Introduction to periodic and pulse signals, various systems
- To be able to time domain analysis.
- To understand the properties of Z-transform
- To be able solve the Fourier series.
- To study Overview of FFT and problems in the fast Fourier transforms.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands periodic and pulse signals, various systems
CO2	Capable of analysis of time domain specification.
CO3	Understands the properties of Z-transform
CO4	Capable to solve the Fourier series.
CO5	Understands Overview of FFT and problems in the fast Fourier transform.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	M	H	M	L	H	M
CO2	H	M	L	M	H	M	L	H	M	L	M	H
CO3	H	M	L	H	M	H	M	L	M	H	M	L
CO4	H	M	M	H	M	L	H	M	H	M	L	H
CO5	L	M	H	M	L	M	H	L	M	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	H	M	L
CO2	H	M	L	M	H
CO3	M	M	L	H	H
CO4	H	M	L	M	H
CO5	M	H	M	M	H

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
					✓				



BBI18E12 **BIOMEDICAL SIGNAL PROCESSING** **3** **0/0** **0/0** **3**

UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS 9

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 9

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 9

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

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING 9

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 9

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

Total No of Periods: 45

TEXT BOOKS:

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

REFERENCE BOOKS:

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



Subject Code: BBI18E13	Subject Name :BIO-MATERIALS AND ARTIFICIAL ORGANS	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 the different classes of materials used in medicine
- To gain knowledge about the application of biomaterials in medicine
- To understand the concept of biocompatibility and the methods of biomaterial testing
- To know about the technologies of biomaterial processing, clinical trials, ethical issues and regulatory standards.
- To gain knowledge in some of the existing designs of artificial organs.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands about the different classes of materials used in medicine
CO2	Familiar with the application of biomaterials in medicine
CO3	Graduate understands the concept of biocompatibility and the methods of biomaterial testing
CO4	The graduate will be able to use technologies of biomaterial processing, clinical trials, ethical issues and regulatory standards.
CO5	Acquires knowledge in some of the existing designs of artificial organs.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	L	M	H	L	M	H	M	L	M
CO2	H	M	H	M	L	M	H	L	H	M	H	M
CO3	H	L	M	M	L	H	M	L	H	M	L	M
CO4	H	M	L	H	M	L	H	M	L	M	H	L
CO5												

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	L	M
CO2	H	M	L	M	H
CO3	H	M	M	H	M
CO4	M	L	H	M	L
CO5	M	H	L	M	H

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
					✓				



BBI18E13 BIO-MATERIALS AND ARTIFICIAL ORGANS 3 0/0 0/0 3

UNIT I STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY 9

Definition and classification of bio-materials -mechanical properties -visco elasticity -wound-healing process - body response to implants - blood compatibility

UNIT II IMPLANT MATERIALS 9

Metallic implant materials -stainless steels -co-based alloys -Ti-based alloys -ceramic implant materials - aluminum oxides -hydroxyapatite glass ceramics carbons -medical applications

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization –polyolefin – polyamides –Acrylic –polymers –rubbers -high strength thermoplastics - medical applications

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Soft-tissue replacements, sutures -surgical tapes, adhesive -percutaneous and skin implants -maxillofacial augmentation -blood interfacing implants -hard tissue replacement implants -internal fracture fixation devices -joint replacements

UNIT V ARTIFICIAL ORGANS 9

Artificial Heart -Prosthetic Cardiac Valves -Limb prosthesis - Externally Powered limb Prosthesis -Dental Implants

Total No of Periods: 45

TEXT BOOKS:

1. PARK J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984

REFERENCE BOOKS:

1. Chua, Chena.J.Y, Wanga.L.P, N.Huang, “Plasma-surface modification of biomaterials”, Materials Science and Engineering: R: Reports, Volume 36, Number 5, 29 March 2002, pp. 143-206 (64)



Subject Code: BBI18E14	Subject Name :RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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 Standardization of Hospital Equipment's
- To gain knowledge on Clinical Engineering
- To study about Networking
- To gain knowledge on Fiber Optic Sensors for Measuring Physiological Parameters
- To learn about EMI and EMC Applied to Hospital Equipment's

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires knowledge on Standardization of Hospital Equipment's
CO2	Gains knowledge on Clinical Engineering
CO3	Graduate understands Networking
CO4	Gains knowledge on Fiber Optic Sensors for Measuring Physiological Parameters
CO5	Acquires knowledge EMI and EMC Applied to Hospital Equipment's

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	L	M	H	L	M	H	L	M
CO2	M	L	H	M	L	M	H	L	M	H	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	M	H
CO2	M	H	L	M	H
CO3	L	M	H	L	M
CO4	M	H	L	M	H
CO5	H	M	M	H	L

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
					✓				



BBI18E14 RECENT ADVANCES APPLIED TO HOSPITAL 3 0/0 0/0 3
ENGINEERING

UNIT I STANDARDISATION OF HOSPITAL EQUIPMENTS 9
Need for standardization -classification of equipment's -international standards -Experimental methods of testing standards -maintenance of standards and recalibration

UNIT II CLINICAL ENGINEERING 9
Hospital design-electrical- airconditioning-sanitation -ventilation -safety regulation to be incorporated in the hospital center -management and legal aspects -latest drug delivery systems for sustained delivery of medicines

UNIT III NETWORKING 9
Importance of networking -LAN features -network topologies -LAN components -network operating system -basic data communication concept -application-LAN and multi-user system -planning and installing LAN in hospital set up

UNIT IV FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS 9
Different optical sources -optical detectors -principle of fiber optic cables -single mode multi-mode -step index and graded index type -sensors based on polarization -interferometer principle -magnetic sensors - application of the sensors in measuring pressure -temperature -flow -rotation and chemical activities - principles of smart sensors

UNIT V EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS 9
Principles of EMI -computation of EMI -measuring techniques to quantify the level of interference - method of suppressing and isolating this unit from interference

Total No of Periods: 45

TEXT BOOKS:

1. Donald R.J. White, "A Handbook of electromagnetic Interference and Compatibility", Vol 4, 5, Published by Donwhite Constant – Maryland, 1972
2. Webster J.G. and Albert M. Cook, "Clinical Engineering Principles and Practices", Printice Hall Inc, Englewood Cliffs, New Jersery, 1979
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech House- 3rd Edition, 1986

REFERENCE BOOKS:

1. Eric Udd, "Fiber Optic Sensors and introduction for engineers and scientists", Wiley Interscience Publication, New Delhi, 1991
2. Bajbai, P.K., "Ceramic – a novel device for sustained long term delivery of drugsBio Ceramic", Vol III
3. Rose Heliman Institute of Technology, Terrahaute, Indian, 1992.
4. S.K. Basandia, "Local Area Network", Golgotia Publishing Pvt Ltd., New Delhi, 1995



Subject Code: BBI18E15	Subject Name :HOSPITAL MANAGEMENT	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	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	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	H	L	M	H
CO3	H	M	L	H	L
CO4	L	M	H	L	M
CO5	H	M	L	M	H

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
					✓				



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BBI18E15 **HOSPITAL MANAGEMENT** **3** **0/0** **0/0** **3**

UNIT I NEED AND SCOPE 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



Subject Code: BBI18E16	Subject Name :SYSTEM THEORY APPLIED TO BIOMEDICAL ENGINEERING	TY / LB/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIO CONTROL SYSTEM	T	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 System Concept
- To Gain Knowledge on Transducer Function
- To Study about Impedance Concept
- To Learn about Periodic Signals, Feedback
- To Gain Knowledge on Simulation of Biological Systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands System Concept
CO2	Acquires knowledge on Transducer Function
CO3	Graduate understands Impedance Concept
CO4	Understands Periodic Signals, Feedback
CO5	Simulation of Biological Systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	H	L	M	H
CO3	H	M	L	H	L
CO4	L	M	H	L	M
CO5	H	M	L	M	H

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
					✓				



BBI18E16	SYSTEM THEORY APPLIED TO BIOMEDICAL ENGINEERING	3	0/0	0/0	3
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UNIT I INTRODUCTION 9

System Concept -System Properties -Piece Wiser Linear Approximation -Electrical Analog for Compliance -Thermal Storage -Mechanical Systems -Step response of a Resistance/Compliant Systems -Pulse Response of First Order System

UNIT II TRANSFER FUNCTION 9

System as an Operator use of Transfer Function -bioengineering of a Coupled System -Example of Transformed Signals

UNIT III IMPEDANCE CONCEPT 9

Circuits for the Transfer Function with Impedance Concept Prediction of Performance.

UNIT IV PERIODIC SIGNALS, FEEDBACK 9

Sinusoidal Functions -Sinusoidal Analysis of Instrumentation System -Evaluation of Transfer Function s from Frequency Response -Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system - General Description of Natural Frequency Damping -Physical Significance of Under Damped Responses - Characterization of Physiological FeedbackSystem -Uses and Testing of System Stability

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9

Simulation of Skeletal music servomechanism -thermo Regulation -Cardiovascular control System -Respiration controls -Oculo Motor System -Endocrine control system and Modeling of receptors

Total No of Periods: 45

TEXT BOOKS:

1. William B. Blesser, "A System Approach to Biomedicine",McGraw Hill Book Co., New York, 1969
2. Manfred Clynes and John H. Milsum, "Biomedical Engineering System", McGraw Hill and Co, New York, 1970

REFERENCE BOOKS:

1. Douglas S. Rigg, "Control Theory and Physiological Feedback Mechanic",The William and Wilkins Co., Baltimore, 1970
2. Richard Skalak and Shu Chien, "Handbook of Biomedical Engineering", McGraw Hill and Co., New York, 1987



Subject Code: BBI18E17	Subject Name :SPECIAL TRANSDUCERS AND INSTRUMENTATION	TY / LB/ ETL	L	T/ S.Lr	P/ R	C
	Prerequisite:	T	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 **basic** concepts of measurement
- To gain knowledge on force, pressure and motion measurement
- To study about chemical and optical transducer
- To learn about temperature and radiation measurement
- To gain knowledge on data acquisition recording

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands basic concepts of measurement
CO2	Acquires knowledge on force, pressure and motion measurement
CO3	Graduate understands chemical and optical transducer
CO4	Understands temperature and radiation measurement
CO5	Understands data acquisition recording

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5							
CO1	M	H	L	M	H							
CO2	M	H	L	M	H							
CO3	H	M	L	H	L							
CO4	L	M	H	L	M							
CO5	H	M	L	M	H							

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			
					✓							



BBI18E17	SPECIAL TRANSDUCERS AND INSTRUMENTATION	3	0/0	0/0	3
UNIT I	BASIC CONCEPTS OF MEASUREMENT				9
Transducer Categories - Characteristics of Transducers Static and Dynamic Characteristics of Measurement					
UNIT II	FORCE, PRESSURE AND MOTION MEASUREMENT				9
Various Transducers Capable of Measuring Low Pressure and Force - Its measuring System - External and Catheter tip Transducers - Transducer to Measure Single Movement and Differential Movements - Velocity Transducer - Seismic Pick Up - Accelerometer					
UNIT III	FLOW MEASUREMENT				9
Transducer to Measure Velocity - Magnitude and Direction Flow various Methods of measuring these Parameter - In vivo and In vitro Type of Measurements					
UNIT IV	CHEMICAL AND OPTICAL TRANSDUCER, TEMPERATURE AND RADIATION MEASUREMENT				9
Ion Sensor - Anion and Cation Sensor - Liquid and solid Ion Exchange Membrane Electrodes - Enzyme Electrodes - Molecular Electrode - Fiber Optic Sensor - Photo Acoustic Sensors- PPG Sensors-Variou Thermal Sensors Including Integrated Circuit Thermal Sensors - Radiation Thermometry and Chemical Thermometry - Scintillation technique - Gas ionization type films					
UNIT V	DATA ACQUISITION RECORDING				9
Signal Conditioners - Single and Multi-Channel data acquisition System - DATA Transmission system - Various Types of recorders - Multichannel column display oscilloscope - Multi colour dot scanner - Magnetic recorder.					

Total No of Periods: 45

TEXT BOOKS:

1. Michael R. Newman, David G. Flemming, "Physical Sensors for Bio Medical Applications", CRC Press Inc, Florida, 1980
2. Rangan C.S., Sarma G.R., And Mani V.S.V., "Instrumentation Devices and System", Tata McGraw Hill Publication Company Limited, New Delhi, 1983

REFERENCE BOOKS:

1. Jacob Kline., "Handbook of Bio Medical Engineering", Avademic Press Inc., San Diego 1988
2. George C. Barney, "Intelligent Instrumentation", Prentice Hall of India, New Delhi, 1988
3. Earnest O.Doebelin., "Measurement System Application and Design", McGraw Hill, New York, 1990



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