DEPARTMENT OF BIOMEDICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
M.TECH BIO MEDICAL ENGINEERING

(FULL TIME) CURRICULUM & SYLLABUS

R 2015

(I – VI SEMESTERS) CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2015)PG-CURRICULUM I TO IV SEMESTERS (FULL TIME) 2015

SEMESTER I

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	MBM101	Biomaterials and implantable devices	4	0	0	4
2	PC	MBM102	Anatomy and physiology	3	0	0	3
3	PC	MBM103	Bio signal processing	3	0	0	3
4	PC	MBM104	Biomedical equipment	3	0	0	3
5	PC	MBM105	Biomedical instrumentation	3	0	0	3
6	PE		Professional Elective I	3	0	0	3
PRACTICAL							
7	PC	MBM1L1	Bio medical Instrumentation lab	0	0	4	2
8	PR	MBM1S1	Technical Seminar	0	0	2	1
			TOTAL	**19**	**0**	**6**	**22**

SEMESTER II

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
1	PC	MBM201	Medical Image Processing	3	0	0	3
2	PC	MBM202	Medical Imaging And Radio Therapy	3	0	0	3
3	PC	MBM203	Fiber optics and Laser Instrumentation	3	0	0	3
4	PC	MBM204	Microcontrollers and its Applications	3	0	0	3
5	PE		Professional Elective II				
6	PE		Professional Elective III	3	0	0	3
7	PC	MBM2L1	Biomedical Signal and Image Processing Lab	**0**	**0**	**4**	**2**
			TOTAL	**15**	**0**	**4**	**20**

SEMESTER III

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PE		Professional Elective IV	3	0	0	3
2	PE		Professional Elective V	3	0	0	3
3	OE		Open Elective I	3	0	0	3
PRACTICAL							
4	PR	MBM3P1	Project Work (phase I) Summer Training Pre-requisite	0	0	12	6
			TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL							
1	PR	MBM4P1	Project Work (phase II)	0	0	24	12
			TOTAL	**0**	**0**	**24**	**12**

OVERALL CREDITS : 69

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No.	Sub Area	Credit As per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Core (PC)	18	14	-	-	32	46.38
2	Professional Elective (PE)	3	6	6		15	21.74
3	Open Electives (OE)	-	-	3	-	3	4.37
4	Project Work, Seminar, Internship, Term Paper, etc. (PR)	1	-	6	12	19	27.53
	Total Credit	22	20	15	12	69	100%
	Total Contact Hour	25	22	21	24	93	

LIST OF ELECTIVES

SUB.CODE	SUBJECT NAME	L	T	P	C
PROFESSIONAL ELECTIVE (PE) - I					
MBME089	Advanced biosensor and transducers	3	0	0	3
MBME053	Human assist devices	3	0	0	3
MBME054	Computer based medical Instrumentation.	3	0	0	3
PROFESSIONAL ELECTIVE (PE) –II					
MBME060	Tissue Engineering.	3	0	0	3
MBME056	Health Hospital and Equipment management.	3	0	0	3
MBME067	Brain Control Interfaces	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - III					
MBME061	Bio MEMS	3	0	0	3
MBME058	Physiological modeling	3	0	0	3
MBME059	Pattern recognition Techniques and Applications	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - IV					
MBME055	Advanced Neural computing.	3	0	0	3
MBME063	Wavelet transforms and its application	3	0	0	3
MBME064	Tele Health technology .	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – V					
MBME062	Principles Of Genetic Analysis	3	0	0	3
MBME065	DSP Integrated Circuits	3	0	0	3
MBME052	Advances in Electronics applied to Hospital Engineering	3	0	0	3

SUB.CODE	SUBJECT NAME	L	T	P	C
OPEN ELECTIVE (OE) –I					
MBME057	Rehabilitation Engineering.	3	0	0	3
MBME066	Bio Mechanics	3	0	0	3
MST070	Research Methodology	3	0	0	3

MBM101	Biomaterials and implantable devices	L	T	P	C
	Total Contact Hours: 60	4	0	0	4
	Prerequisite: Basic Biomaterials (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

To study about the artificial organs and various medical materials like implant materials, polymeric implants, tissue replacement implants and its applications.

COURSE OUTCOMES (COs)

CO1	To understand the basic definition and classification of various biomaterials
CO2	To learn the properties of various biomaterials, metallic implants and alloys
CO3	To apply the mechanical properties of various materials in therapeutic applications
CO4	To get introduced about different artificial organs
CO5	To understand the properties of bio glass, bio ceramics and biopolymers.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Programme Outcomes (POs)											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	M	H			H			M			
CO2					M							L
CO3	M		M					M				
CO4		L								L		
CO5												

Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			

Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT-I BIOMATERIAL SCIENCE `

(9)

Definition and classification of Biomaterials, Application of Polymers-Metals- Ceramics and Composite Biomaterials

UNIT-II BIOLOGICAL MATERIALS

(9)

Structure, Property relationship of Biological Materials- Thermodynamics of Structural changes- Strengthening Mechanisms

UNIT-III BIOCOMPATIBILITY

(9)

Biocompatibility- introduction of Biological environment, Material response function and degradation of materials in vivo- host response- biological effects of implants- Methods of test for biological performance.

UNIT-IV IMPLANT MATERIALS

(9)

Metallic implant materials- Ceramic implant materials- Polymeric implant materials- hard tissue replacement implant.

UNIT-V BIOPOLYMERS

(9)

Physio Chemical Characteristics of Biopolymers- biodegradable polymers for medical purposes- tailor made composite materials for biomedical use-synthetic Polymeric Membranes and their biological applications-biopolymers in .Controlled release systems. Artificial skin surface Modification of biopolymer materials.

References:

1. Park. J.B. "Biological science and engineering", Plenum Press, 1994.
2. Jonathan Black "Biological Performance of Materials', Marcel Dekker", 1981.
3. Piskin.E. & Hoffmann.A.S. "Polymeric biomaterials" Martinus Nijihoff pub, 1986
4. http://www.asminternational.org/documents/10192/1849770/06974G_Chapter_1.pdf

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM102	ANATOMY AND PHYSIOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Biology (+2 level)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

To understand basics of Human Anatomy and Physiology. To study the organs and systems involved in body functions.

To apply the knowledge gained about the organ functions, reflexes, and special senses into biomedical engineering field.

COURSE OUTCOMES (COs)

CO1	Learn the basic terminologies, structural and functional elements of human body
CO2	Understand the physiological aspects of respiratory and cardiac system
CO3	Learn the structure and function of nervous tissue, visual and auditory pathways
CO4	Analyze the process of temperature regulation; understand the process of GI reflex
CO5	Attain a good knowledge on the role of hormones and functions of Endocrine gland

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	COs	Programme Outcomes (POs)											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
	CO01	M	L	H	L	M	M	M	M				
	CO02	M	L	H	L	M	M	M	M				
	CO03	M	L	H	L	M	M	M	M				
	CO04	M	L	H	L	M	M	M	M				
	CO05	M	L	H	L	M	M	M	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CELL PHYSIOLOGY 9

Cell structure, Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Recording of Action potentials, patch clamp, Action potential in nerve, Muscle and Heart.

UNIT II GASTROINTESTINAL AND RESPIRATORY SYSTEM 9

Structure of gastrointestinal system, layers in Gastro-intestinal System (deglutition, Peristalsis) movement in stomach, small intestine and movements in GI tract and factors regulating the movement. Respiratory pathway, volumes capacities and measurement, respiratory centers and its regulation of respiration, Artificial Respiration

UNIT III ENDOCRINE AND NEURAL REFLEXES 9

Mention of Endocrine glands general hormonal action, Second messengers, anterior and posterior pituitary hormones. Components in a Simple reflex. Structure of kidney and micturition reflex, Cystometerogram.

UNIT IV CARDIOVASCULAR AND SPECIAL SENSES 9

Structure of Heart, conducting pathway and ECG, BP and its measurements. Structure of Eye and Ear, errors of refraction, photochemistry of vision and visual pathway, Middle Ear mechanics, organ of Corti and Auditory pathway, Audiometers**.**

UNIT V NERVOUS SYSTEM 9

Neuron, properties of Synapse, Cross section of spinal cord, ascending and descending tracts, EEG, Automatic nervous system, body temperature regulation. Cortical functions.

TOTAL: 45 PERIODS

REFERENCES

1. Guyton 'Text book of Medical Physiology – WB Jaunder company Philadelphia - 10 edition 2002
2. Cyrul A Keele and Eric Neil – Samsons Wrights Applied physiology – Oxford University press New Delhi – 1991
3. Ranganathan T S,Text Book of human Anatomy S. Chand and company New Delhi – 1994
4. Best and Taylor, The livery Body – BC publication New Delhi 1980
5. https://www.khanacademy.org/science/health-and-medicine/human-anatomy-and-physiology

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		

6	End Semester Examinations	

MBM103	Bio-signal processing	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Digital Signal Processing (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse
- response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multi-rate and adaptive filters

COURSE OUTCOMES (COs)

CO1	Apply DFT for the analysis of Digital Signals & Systems
CO2	Design IIR and FIR Filters
CO3	Characterize finite word length effect on filters
CO4	Design the Multi-Rate Filters
CO5	Apply Adaptive Filters to equalization

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H			M	H		M			M		M
CO2			M									
CO3	M			H						M		
CO4					H		H					
CO5	H									H		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals,

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

TOTAL: 45 PERIODS

REFERNCES

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, ‘Biomedical Signal Analysis-A case study approach’, Wiley- Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, ‘Digital Signal processing- A Practical Approach’ Pearson education Ltd., 2002
5. Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.
6. K.P.Soman,K.I Ramachandran,”Insight into wavelet from theory to practice”, PHI, New Delhi,2004
7. John L.Semmlow,” Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc.,New York,2004
8. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”, CRC – Taylor and Francis,New York,2006

9. D.C.Reddy,"Biomedical Signal Processing – Principles and Techniques",TMH,New Delhi,2005
10. Gari D.Clifford, Francisco Azuaje and Patrick E.McSharry," Advanced Methods and Tech for ECG Data Analysis", ARTECH House,Boston,2006.

11. http://home.ee.ntu.edu.tw/classnotes/bme2/2007/6_11_07.pdf

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM104	BIOMEDICAL EQUIPMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Knowledge in Equipments				
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES

• To provide practice on recording and analysis of different Bio potentials
• Study the function of different Therapeutic equipments.

COURSE OUTCOMES (COs)

CO1	IC circuits, Op-amps, rectifiers and its applications
CO2	Safety concerns in hospitals
CO3	Use of filters in biomedical applications
CO4	Different types of read-out devices used
CO5	Use of timers and counters

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		Programme Outcomes (Pos)											
	COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					
	CO5	H									H		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I CARDIAC CARE UNIT 9

Pacemakers - different types, batteries for pacemakers. AC defibrillators, asynchronous and synchronous DC defibrillators, patient monitoring system.

UNIT II NEUROLOGY EQUIPMENT 9

Evoked response - Auditory, Visual and Somato sensory Depth recording, Stereotaxy , EEG controlled Anesthetic monitor, Biofeedback equipments, Spinal reflex Measurement, Transcutaneous nerve stimulator

UNIT III PHYSIOTHERAPY AND DIATHERMY EQUIPMENT 9

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety- Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser

UNIT IV LASER AND ULTRASONIC APPLICATION 9

Principles of Laser action, Different types and clinical applications of laser, ultrasonic frequency for medical application, different modes of Display A, B, and C ultrasonic probes, Real time echo and 2D scanner, Application of Ultrasonic for diagnosis.

UNIT V RECENT TRENDS 9

Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application , principles of Fibre optics cables, Endoscopy, Laparoscopy, ophthalmic equipments- slit Lamp, Tonometer, Retinal response Plotter, principles of Bio telemetry, principles of Lithotripsy.

TOTAL: 45 PERIODS

REFERENCES

1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
2. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
3. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
5. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
6. Heinz Kresse – Handbook of Electro medicine. John Wiely & Sons – Chrchester – 1985
7. https://en.wikipedia.org/wiki/Medical_equipment

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM105	BIOMEDICAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Instrumentations				
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES

The student should be made to:

- Gather basic knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.
- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

COURSE OUTCOMES (COs)

CO1	Explain about measurements of parameters related to respiratory system
CO2	Describe the measurement techniques of sensory responses
CO3	Analyze different types and uses of diathermy units
CO4	Discuss ultrasound imaging techniques and its usefulness in diagnosis
CO5	Outline the importance of patient safety against electrical hazard

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	Programme Outcomes (Pos)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H			M	H		M			M		M
CO2			M									
CO3	M			H						M		
CO4					H		H					
CO5	H									H		

3 Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			

4 Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS 9

Categories and Characteristics of Transducer, Signal conditioning units, Multichannel data acquisition system, various types recorders, necessity for low noise pre amplifiers, Difference amplifier, Chopper amplifier, Different types of electrode and its equivalent circuits.

UNIT II BIOPOTENTIAL RECORDING 9

ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform, frequency spectrum, abnormal waveform.

UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS 9

Respiration rate, Pulse rate, Temperature, Blood Pressure, O_2 , CO_2 measurements, Respiratory volume measurement, BMR measurement, Plethysmography technique, Impedance technique- Bipolar and Tetra polar circuits, Detection of various physiological parameters using impedance technique

UNIT IV BLOOD FLOW METER AND BLOOD CELL COUNTER 9

EM and ultrasonic blood flow meters, indicator dilution method, Thermodilution method, Manual and Automatic Counting of RBC, WBC and Platelets.

UNIT V BIO-CHEMICAL MEASUREMENTS& BIOSENSORS 9

pH, pC02, p02, pHCO3 and electrophoresis, colorimeter, spectrophotometer, flame photometer, autoanalyser, Biosensors.

TOTAL =45 PERIODS

REFERENCES

1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation , John Wiley and sons Newyork 1975
2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
4. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.

Richard S.Cobbold Transducers for Biomedical Measurements; Principle and applications- John Wiley and sons,1992.

https://accessengineeringlibrary.com/browse/handbook-of-biomedical-instrumentation-third-edition

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey

3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM1L1	BIO MEDICAL INSTRUMENTATION LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Basic Knowledge to handle Instruments				
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES

• To provide practice on recording and analysis of different Bio potentials
• Study the function of different Therapeutic equipments.

COURSE OUTCOMES (COs)

CO1	IC circuits, Op-amps, rectifiers and its applications
CO2	Safety concerns in hospitals
CO3	Use of filters in biomedical applications
CO4	Different types of read-out devices used
CO5	Use of timers and counters

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		Programme Outcomes (POs)											
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					
	CO5	H									H		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

1. Construction and testing of Instrumentation amplifier

2. Design of Instrumentation amplifier using Single IC and Single supply
3. Patient monitoring system and Bio-telemetry.
4. Plotting of Human auditory response using audiometer.
5. Performance and testing of Surgical Diathermy unit using Diathermy analyzer.
6. Recording of Electromyogram.
7. Construction and testing of nerve stimulator.
8. Study of ECG machine.
9. Study of EEG machine.

Course Assessment Methods:

Direct		Indirect	
1	Observation Book	1	Course and Survey
2	Record Book	2	Faculty Survey
3	Model Examination	3	Industry
4	Viva Voce	4	Alumni
5	End Semester Examinations		

MBM201	MEDICAL IMAGE PROCESSING	L	T	P	C
	Total Contact Hours: 45	3	1	0	4
	Prerequisite: Knowledge in Image processing (B.Tech/B.E Level)				
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES

- To study the production of x-rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about the various medical imaging techniq
CO2	Students will be able to understand the various diagnostic applications of the medical imaging techniques.
CO3	Students will get the clear domain knowledge the image fundamentals and image transfo
CO4	Study the image enhancement techniques
CO5	Study the image restoration procedures and image compression procedures.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1													
2		**Cos**	**Programme Outcomes (Pos)**										
			PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
		CO1	H	M	H			H			M			
		CO2					M							L
		CO3	M		M					M				
		CO4		L								L		
		CO5			H			H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I IMAGE FUNDAMENTALS **9**

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT II IMAGE PREPROCESSING 9

Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations, Image restoration – Image degradation model, Inverse and Weiner filtering. Image Compression – Spatial and Transform methods

UNIT III MEDICAL IMAGE RECONSTRUCTION 9

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear Medicine Imaging Modalities-SPECT,PET, Molecular Imaging

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

REFERENCES

1. Atam P.Dhawan, 'Medical Image Analysis', Wiley Interscience Publication, NJ, USA 2003.
2. R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education, 2002.
3. Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint 2003.
4. Alfred Horowitz, 'MRI Physics for Radiologists – A Visual Approach', Second edition Springer Verlag Network, 1991.
5. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006
6. John L.Semmlow,"Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
7. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

8. https://en.wikipedia.org/wiki/Medical_imaging

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBM202	MEDICAL IMAGING AND RADIO THERAPY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Knowledge in Imaging Techniques				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To introduce the basics of signal processing and its application to biological systems.
- To make the students to understand the fundamentals of image processing and its

COURSE OUTCOMES (COs)

CO1	Know the principle behind the production of X-Rays, its types and applications
CO2	Understand the principle of CT
CO3	About Gamma camera and radiation detectors
CO4	Principle of MRI and fMRI
CO5	Therapeutic effects of various radiation sources

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

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

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I X – RAYS
9

Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, dental X- ray units.

UNIT II TOMOGRAPHY 9

Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography.

UNIT III EMISSION IMAGING
9

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT.

UNIT IV MAGNETIC RESONANCE IMAGING
9

Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterisation, MR Spectroscopy, Functional MRI.

UNIT V THERAPY USING X – RAYS AND ISOTOPES
9

Direct and Indirect effects of high energy radiation, Units for radiation Exposer, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

Total= 45 Periods

REFERENCES:

1. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
2. Jacobson B. and Webster J.G., Medicine and Clinical Engineering, Prentice Hall India, New Delhi, 1999.
3. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chich~ster, 1986.
4. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988.
5. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, Mc Graw Hill Publications, New York,1995
6. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics, Churchill Livingston, 5th Edition.
7. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince

   MRI from picture to proton, Cambridge University press, New York 2006
8. https://en.wikipedia.org/wiki/Radiation_therapy

MBM203	FIBER OPTICS AND LASER INSTRUMENTATIO	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Knowledge in laser (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers

COURSE OUTCOMES (COs)

CO1	Fundamental principles of light through an optical fiber and various optical light sources
CO2	Industrial measurements using optical light and optical sensors
CO3	Characteristics of LASER and its types/configuration
CO4	Applications of LASERS
CO5	Hologram-its definition, basic principle, and medical applications

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		Programme Outcomes (POs)											
	COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		
	CO5						H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light through a fiber- different types of fibres and their properties, transmission characteristics of optical fibre- absorption losses- scattering losses- dispersion- optical fiber measurement- optical sources- optical detectors- LED- LD- PIN and APD.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors- fiber optic instrumentation system- different types of modulators- detectors- application in instrumentation- interferometric method of measuring length- moire fringes- measurement of pressure, temperature, current, voltage, liquid level and strain- fiber optic gyroscope- polarisation maintaining fibers.

UNITIII LASER FUNDAMENTALS 9

Fundamental characteristics of lasers- three level and four level lasers- properties of laser- laser modes- resonator configuration- Q switching and mode locking- cavity dumping- types of lasers: gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect- material processing, laser heating, welding, melting and trimming of materials- removal and vaporisation.

UNIT V HOLOGRAM AND MEDICAL APPLICATION 9

Holography- basic principle: methods, holographic interferometry and applications, holography for non destructive testing- holographic components- medical applications of lasers- laser and tissue interaction- laser instruments for surgery, removal of tumours of vocal cords, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

References:

1. Abdul AL Azzawi, Fibre Optics: Principles and Practices, CRC Press (2006).

KR Nambiar, Lasers: Principles, Types and Applications, New Age International Publishers (2006).

2. https://en.wikipedia.org/wiki/Optical_fiber

MBM204	MICROCONTROLLERS AND ITS APPLICATION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in Microprocessor (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To introduce microcontroller, the role of microcontrollers **.**Types and selection, its application and examples.
- To study the microcontroller resources and Family members, bus widths program and data memory parallel ports. D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations
- To study Interrupt structures programmable timers, real time clock, latency, interrupt, density and interval constraints.
- To study CPU register- structure- addressing modes- instruction sets- assembly languages- assemblers.
- To study Queues, tables and strings, program organization, microcontroller expansion methods, I/O hardware alternatives, development tools, RTOS.

COURSE OUTCOMES (COs)

CO1	To learn introduce microcontroller the role of microcontrollers. The types and selection.
CO2	To learn D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations.
CO3	To have a clear view Interrupt structures programmable timers, real time clock.
CO4	To learn CPU register its structure and its addressing modes and instruction sets.
CO5	To learn I/O hardware alternatives, development tools, RTOS, motorola MC68HC11.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1		Programme Outcomes (POs)											
	COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**						M						
	CO2		H			H	H						
	CO3		H					H		M			
	CO4	H			H							H	`
	CO5			H		M					H		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Course Contents:

UNIT I - OVERVIEW OF ARCHITECTURE AND MICROCONTROLLER RESOURCES 9

Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT II - INSTRUCTION SET OF 8051 FAMILY MICROCONTROLLERS 9

Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT III - REAL TIME CONTROL 9

Interrupts: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-Maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051. **Timers:** Programmable Timers in the MCUs – Free running counter and real time control – Interrupt interval and density constraints.

UNIT IV - 8051 PROGRAMMING AND APPLICATIONS 9

Interfacing Serial I/O (8251)- parallel I/O (8255) -Keyboard and Display controller (8279) - ADC/DAC interfacing - Inter Integrated Circuits interfacing (I2C Standard)-LCD- LED and Array of LEDs-Interfacing with the Flash Memory- Prototype MCU based Measuring instruments – Robotics and Embedded control Bus: RS232C-RS485-GPIB8051

UNITV- REAL TIME OPERATING SYSTEM FOR MICROCONTROLLERS 9

Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers. ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development tools.

TEXT BOOKS:

1. Raj Kamal, "*Microcontrollers Architecture, Programming, Interfacing and System Design"*, Pearson Education, 2005.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "*The 8051 Microcontroller and Embedded Systems",* Pearson Education Asia, New Delhi, 2003

REFERENCES:

1. Deshmuk.A.V, "*Microcontrollers (Theory & Applications)*", TMH, 2005.
2. John B. Peatman, "*Design with PIC Microcontrollers*", Pearson Education, 2005.

3. Kenneth J Ayala, "*The 8051 Microcontroller Architecture Programming and Application*", 2nd Edition, Penram International Publishers (India), New Delhi, 1996.
4. Rafi Quazzaman.M, "*Microprocessors Theory and Applications: Intel and Motorola*", Prentice Hall of India, Pvt. Ltd., New Delhi, 2003.
5. https://en.wikipedia.org/wiki/Microcontroller

Course Assessment Methods:

Direct		**Indirect**	
1)	Internal Tests	1	Course and Survey
2)	Assignments	2	Faculty Survey
3)	End Semester Examinations	3	Industry
		4	Alumni

MBM2L1	Biomedical Signal and Image Processing Lab	L	T	P	C
	Total Contact Hours:	0	0	4	2
	Prerequisite:				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To study the production of x-rays and its application to different medical Imaging techniques.
- •To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about the various medical imaging techniques.
CO2	Students will be able to understand the various diagnostic applications of the medical imaging techniques.
CO3	Students will get the clear domain knowledge the image fundamentals and image transfo
CO4	Study the image enhancement techniques
CO5	Study the image restoration procedures and image compression procedures.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1													
2	**COs**	**Programme Outcomes (Pos)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
	CO1	H	M	H			H			M			
	CO2					M							L
	CO3	M		M					M				
	CO4		L								L		
	CO5			H			H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. Representation of time-series; computation of convolution.

2. Response of a difference equation to initial conditions; stability.
3. DFT computation.
4. Computational experiments with digital filtering.
5. Sampling and waveform generation.
6. FIR and IIR filters implementation.
7. Simulation of Biosignals and Analysis of ECG signals, EEG signals and EMG signals.
8. Image arithmetic operations – Addition, Subtraction, Multiplication and Division of 2 images.
9. Gray level transformation – Log transformation, Power law transformation and Histogram equalization.
10. Spatial Filters-Salt and pepper noise, speckle noise, Average Filter and Gaussian Filter
11. Properties of Fourier transform – zeros, FFT Discrete Fourier transform, Two dimensional Discrete Fourier transform.
12. Properties of Fourier transform- FFT SHIFT, IFFT SHIFT

Course Assessment Methods:

Direct		**Indirect**	
1	Observation Book	1	Course and Survey
2	Record Book	2	Faculty Survey
3	Model Examination	3	Industry
4	Viva Voce	4	Alumni
5	End Semester Examinations		

MBME089	Advanced biosensor and transducers	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic knowledge of electronic devices and sensors				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.
3. Know the different display and recording devices.

COURSE OUTCOMES (COs)

CO1	Describe the purpose and methods of measurements
CO2	Explain different display and recording devices for various applications.
CO3	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications
CO4	Remember and understand the concepts, types, working and practical applications of important biosensors.
CO5	Know some of the commonly used biomedical transducers

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1			H									
	CO2			H	H		M						
	CO3		M		H		H						
	CO4	H	M		H								`
	CO5			H		H							

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT - I **9**

SCIENCE OF MEASUREMENT

Units and Standards - calibration methods - statics calibration - classification of errors, error analysis - statistical methods - odds and uncertainity.

UNIT - II **9**
CHARACTERISTICS OF TRANSDUCERS

Static characteristics - accuracy, precision, sensitivity, linearity etc - mathematical model of transducers - zero first - order and second - order transducers - response to impulse step, ramp and sinsoidal inputs.

UNIT - III **9**
VARIABLE RESISTANCE TRANSDUCERS

Principle of operation, construction details, characteristics and applications of resistance potentiometers, strain gauges, resistance thermometers, thermistors, hot-wire aneometer, piezoresistive sensors and humidity sensors.

UNIT - IV **9**
BIOSENSORS - PHYSIOLOGICAL RECEPTORS - J RECEPTORS

Chemo receptors, Baroreceptors, Touch receptors, Biosensors - Working Principle and Types, Applications.

UNIT - V **9**
OTHER TRANSDUCERS

Piezoelectric tranducers, magnetostrictive transducer, IC sensor digital transducers - smart sensor - fibre optic transducers.

TOTAL: 45 PERIODS

Text Books:

1. Doeblin. E. O, Measurment Systems, McGraw Hill Book Co. 1998
2. Renganathan S, Transducer Engineering, Allied Publishers, Chennai,2000.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME062	PRINCIPLES OF GENETIC ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Knowledge on genetic				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. To study the Pattern of inheritance and Chromosomal basis of inheritance.
2. To know DNA sequencing, DNA Amplification.
3. To study the Protein synthesis and regulation of gene expression.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Chromosome mapping by recombination , Genetics of Bacteriaand viruses.
CO2	Learn the DNA structure and replication, DNA sequencing, DNA Amplification andDNA Hybridization.
CO3	To learn Gene isolation and manipulation.
CO4	To learn Genetic basis of development.
CO5	Study the Quantitative Genetics and Evolution Genetics.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Programme Outcomes (POs)											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H			M	H		M			M		M
CO2			M									
CO3	M			H						M		
CO4					H		H					
CO5	H									H		

Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			

Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INHERITANCE - GENETIC ANALYSIS

Pattern of inheritance, Chromosomaby basis of inheritance, Chromosome mapping recombination, Genetics of Bacteriaand viruses.

UNIT II DNA AND PHENOTYPE

From Gene to Phenotype, DNA structure and replication- DNA sequencing, DNA Amplification, DNA Hybridisation and DNA Polymorphism, RNA transcription and

processing, Protein synthesis and regulation of gene expression.

UNIT III GENOME STRUCTURE AND GENETIC ENGINEERING 9

Gene isolation and manipulation, Genomics, mutations, repair and recombination, site directed mutagenesis, large-scale chromosomal changes and genetic polymorphism.

UNIT IV GENETIC PROCESSES 9

Gene function, Genetic organization, Genetic regulation, normal and cancer cells, Genetic basis of development

UNIT V IMPACT OF GENETIC VARIATION 9

Population Genetics, Quantitative Genetics, Evolution Genetics.

TOTAL = 45 PERIODS

REFERENCES

1. Watson. J. etal, " Molecular Biology of the Gene ", 5th Edition, Pearson Publication, 2004.
2. Griffiths, Wesslers, Lewontin, Bart Gel, Suzuki, Miller "Introduction to Genetics Analysis", – W.H Freeman & company, New York 8th Edition - 2005.
3. Glick, B.R and J.J Pasternak "Molecular Biotechnology", Principles and application of Recombinant DNA" 3rd Edition ASM Press, 2003
4. Karp, Gerald." Cell and Molecular Biology". Concepts and Experiments, 4th Edition, John Wiley Sons, 2005.
5. Weaver. R.F. " Molecular Biology " 3rd Edition, McGraw – Hill, 2005.
6. Tom Strachan, Andrew P Read "Human molecular Genetics" 3rd Edition, Garland Publishing – 2004.

MBME054	COMPUTER BASED MEDICAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- Computer assisted instruction in education, including biomedical engineering education, has been explored and changed dramatically for more than two decades.
- The Internet, with its capacity to transmit synchronous and asynchronous audio, text, and graphics, presents educators with tremendous opportunities for distance education and independent learning.
- In this work, we have developed a new educational hypermedia for medical instrumenta courses.

COURSE OUTCOMES (COs)

CO1	About computer hardware components and its interface
CO2	Different microprocessors and its architecture
CO3	Pentium processors and its architecture
CO4	Telemedicine and applications
CO5	Biometric systems in use today.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		Programme Outcomes (POs)											
	COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		
	CO5						H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I PC HARDWARE AND OVERVIEW 9

Hardware – BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board – I / O slots – Mother Board logics- Memory and I/O map, Peripheral interfacing and controllers- Serial and Parallel interface – CRT Display Adapter – FDC – HDC – PC buses

UNIT II 80186, 80286, 80386 AND 80486 MICROPROCESSORS 9

80186 Architecture, Enhancements of 80186 – 80286 Architecture – Real and Virtual Addressing Modes – 80386 Architecture – Special Registers – Memory Management – Memory Paging Mechanism – 80486 Architecture – Enhancements – Cache Memory Techniques – Exception Handling – Comparison of Microprocessors (8086 – 80186 – 80286 – 80386 – 80486).

UNIT III PENTIUM MICROPROCESSORS 9

Pentium Microprocessor Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II Microprocessor Architecture – Pentium III Microprocessor Architecture – Pentium III Architecture – Pentium IV Architecture – Comparison of Pentium Processors.

UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING 9

Plug-in-data acquisition and Control Boards, Data acquisition using GPIB and Serial Interfaces and Programming in C, Virtual reality – Multimedia - Telemedicine – Computers in Critically Care Units and radiological centres

UNIT V BIOMETRICS FOR NETWORK SECURITY 9

Introduction to Biometrics and its characteristics, Finger print technology, feature extraction and classification, Face recognition and hand geometry - feature extraction and classification, Biometric authentication system

TOTAL = 45 PERIODS

REFERENCES

1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech

Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME060	TISSUE ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basic biomaterials and artificial organs				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. To study the Tissue Exchange and Tissue Development.
2. To know the Cell growth and differentiation, Cell and tissue mechanism.
3. To study the cell adhesion, cell migration, cell aggregation and tissue equivalent.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Tissue engineering, Element of Tissue development.
CO2	Learn the Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.
CO3	To learn Delivery molecular agents in tissue engineering, control releaser agents in time and space.
CO4	To learn cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.
CO5	Study the Replacement in Tissue structure or Functional Tissue engineering cartilage.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Programme Outcomes (POs)											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		H			H			M			
CO2					M							L
CO3	M		M									
CO4		L								L		
CO5						H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I FUNDAMENTAL OF TISSUE ENGINEERING 9

Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development.

UNIT II CELLULAR STUDIES 9

Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

UNIT III TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT 9

Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space.

UNIT IV INTRODUCTION TO POLYMERS 9

Non degrade polymer, Bio degradable polymer, cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.

UNIT V APPLICATION OF TISSUE ENGINEERING 9

Artificial organs, synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin, and nerve regeneration.

TOTAL = 45 PERIODS

REFERENCES

1. W Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press inc New York 2004
2. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME053	HUMAN ASSIST DEVICES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To know the various biopotential recordings so as to enable students to record various biosignals.
- To know the various functional blocks present is cardiac care units so that the students can handle these equipments with care and safety.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.
- To study the concept of various assist devices so as to enable the students to develop new assist devices.
- To introduce the recent trends in field of diagnostic and therapeutic equipments.

COURSE OUTCOMES (COs)

CO1	Explain about measurements of parameters related to respiratory system
CO2	Describe the measurement techniques of sensory responses
CO3	Analyze different types and uses of diathermy units
CO4	Discuss ultrasound imaging techniques and its usefulness in diagnosis
CO5	Outline the importance of patient safety against electrical hazard

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					
	CO5	H									H		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition for H/L System, Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

UNIT II CARDIAC ASSIST DEVICES 9

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthodic System, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthodic devices, Haptic Devices

UNIT V RESPIRATORY AND HEARING AIDS 9

Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters, Types of Deafness, Hearing Aids, Construction and Functional Characteristics

TOTAL = 45 PERIODS

REFERENCES

1. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.
2. Andreas.F.Vonracum, Hand book of bio material evalution, Mc-Millan publishers, 1980.
3. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982
4. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
5. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.

Course Assessment

Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		

SYLLABUS

MBME067	BRAIN CONTROL INTERFACES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: knowledge on neural networks				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

COURSE OUTCOMES (COs)

CO1	To learn EEG Data Acquisition ,Pre-processing ,Hardware and Software and Artifacts**.**
CO2	Study the Case Study of Brain Actuated Control of Khepera Mobile Robot.
CO3	Learn the Movement Related EEG Potentials and Mental States and Visual Evoked Potential Based – P300 component.
CO4	To learn Laplacian Filters their Linear and Non-linear Features.
CO5	To learn Vector Quantization and Gaussian Mixture Modeling.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	M			H			M			M
CO2				H			H			M	H	
CO3		M			M	H			M			
CO4			M				H					M
CO5	H				M	M				M	H	

Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√		

Approval: 37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INTRODUCTION TO BCI **8**

Concept of BCI – Invasive and Non-invasive Types – EEG Standards – Signal Features – Spectral Components – EEG Data Acquisition – Pre-processing – Hardware and Software – Artifacts – Methods to Remove – Near Infrared BCI.

UNIT II BCI APPROACHES **7**

Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

UNIT III EEG FEATURE EXTRACTION METHODS **10**

Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering – PCA – Laplacian Filters – Linear and Non-linear Features.

UNIT IV EEG FEATURE TRANSLATION METHODS **10**

LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

UNIT V CASE STUDY **10**

Case Study of Problems in BCI Competition III(2005) – Dataset I, II, III, IV and V – Solutions. Case Study of Brain Actuated Control of Khepera Mobile Robot.

TOTAL = 45 PERIODS

REFERENCES:

1. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
2. Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition, 2002
3. R.Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981. ArnonKohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, ocaRato, Florida.
4. Bishop C.M, “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995
5. TorstenFelzer, “On the possibility of Developing a Brain Computer Interface”, Technical Report, Technical University of Darmstadt, Germany, 2001.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME061	BIO MEMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basic electronic and sensors				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. To study the Working principle of Microsystems.
2. To know System modeling and properties of materials.
3. To study the Fundamental principle of MOEMS technology.

COURSE OUTCOMES (COs)

CO1	To learn objectives of materials for MEMS and Microsystems and micromachining.
CO2	Learn the Peltier effect heat pumps and thermal flow sensor.
CO3	To learn digital micromirror devices, light detectors, optical switch.
CO4	To learn expression for liquid flow in a channel.
CO5	Study the micro system approaches to polymerase chain reaction (PCR).

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNITI MEMS AND MICROSYSTEMS 9

Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

UNIT II MICROSENSORS AND ACUATORS 9

Mechanical sensors and actuators – beam and cantilever, piezoelectric materials, thermal sensors and actuators- micromachined thermocouple probe, Peltier effect heat pumps, thermal flow sensors, Magnetic sensors and actuators- Magnetic Materials for MEMS, Devices

UNIT III MICRO OPTO ELECTRO MECHANICAL SYSTEMS 9

Fundamental principle of MOEMS technology, light modulators, beam splitter, microlens, digital micromirror devices, light detectors, optical switch

UNIT IV MICROFLUIDIC SYSTEMS 9

Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system

UNIT V BIOMEMS 9

Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip

TOTAL = 45 PERIODS

REFERENCES

1. Tai Ran Hsu , " MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. NitaigourPremchandMahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Wanjun Wang, Steven A.Soper " BioMEMS- Technologies and applications", CRC Press,Boca Raton,2007
4. Abraham P. Lee and James L. Lee, BioMEMS and Biomedical Nano Technology, Volume I, Springer 2006.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME058	PHYSIOLOGICAL MODELING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge anatomy& physiology				
	Course Designed by : Biomedical				

OBJECTIVES

1. To study the concept and different mathematical techniques applied in analyzing any given system
2. To learn the analysis of given system in time domain and frequency domain
3. To study the stability analysis of the given system

COURSE OUTCOMES (COs)

CO1	Analyze the time and frequency domains of the given system using different mathematical techniques
CO2	Learn the basics of control systems
CO3	Time and frequency response analysis
CO4	Bio-control system definition and modeling
CO5	Study the model of eye, respiratory system, etc

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INTRODUCTION 9

System Concept, System Properties, Piece-Wise 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, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT III PERIODIC SIGNALS 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.

UNIT IV FEEDBACK 9

Characterization of physiological feedback systems, uses and testing of system stability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9

Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

L =45 TOTAL = 45 PERIODS

REFERENCES

1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.
2. ManfreoClynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.
3. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William and Wilkins Co, Baltimore, 1970 .
4. Richard Skalak and ShuChien, Hand Book of Biomedical Engineering, McGraw Hill and Co, New York, 1987.
5. Michael C.K. Khoo, "Physiological Control System" - Analysis, Simulation and Estimation"- Prentice Hall of India, New Delhi, 2001

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME059	PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS	L	T	P	C
		3	0	0	3
	Prerequisite:				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. To study the concept and different supervised learning techniques applied in Bayesian parameter estimation any given system
2. To know the various functional hierarchical clustering, minimum distance Pattern classifier.
3. To study the stability analysis feature selection through functional approximation
4. To study the concept of fuzzy syste.

COURSE OUTCOMES (COs)

CO1	Analyze the time Discriminant functions and Supervised learning mathematical techniques.
CO2	Learn the Clustering for unsupervised learning and classification
CO3	fuzzy automata and languages- fuzzy control method- fuzzy decision making.
CO4	Study the Target classification of Cancer cells and Cell cytology classification.
CO5	Binary selection Elements of formal grammars, syntactic description.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I OVERVIEW OF PATTERN RECOGNITION 9

Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation - Perceptron Algorithm-LMSE Algorithm-Prob-lems with Bayes Approach-Pattern classification by distance functions - minimum distance Pattern classifier.

UNIT II UNSUPERVISED CLASSIFICATION 9

Clustering for unsupervised learning and classification ,clustering concepts C- means algorithm - hierarchical clustering - Graph theoretic approach to pattern clustering- Validity of clustering solutions.

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms - feature selection through functional approximation - Binary selection Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV FUZZY SYSTEMS 9

Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – fuzzy automata and languages- fuzzy control method- fuzzy decision making.

UNIT V RECENT ADVANCES AND APPLICATIONS 9

Principle of neuro fuzzy techniques, Application of PR in image segmentation - Credit scoring - Techniques for colon endoscopy - Target classification of Cancer cells - Cell cytology classification

TOTAL = 45 PERIODS

REFERENCES

1. Duda R.O., and Hart P.G.,Pattern Classification and scene analysis, JohnWiley, New York, 1973.
2. Robert J. Schalkoff , Pattern recognition: Statistical, Structural and Neural approaches, John Wiley and Sonslnc, New York, 1992.
3. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.
4. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London,1999.
5. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
6. Timothy Ross, Fuzzy Logic with Engineering applications,2nd Edition John Wiley and sons,West Sussex,2004.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME056	HEALTH HOSPITAL AND EQUIPMENT MANAGEMENT	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basic Principle of management				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

To expose the students for planning and operation of hospitals in a detailed manner which will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.

•To introduce the equipment maintenance management skills and how to protectequipment from electromagnetic interferences.

COURSE OUTCOMES (COs)

CO1	Expert in understanding the various health policies
CO2	Planning activities at health care centres.
CO3	Equipment installation,service & calibration needs
CO4	Organizing maintenance operations
CO5	Function of a clinical engineer in a hospital

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I HEALTH SYSTEM 9

Health organisation of the country, the State, the Cities and the Region, Health Financing System, Organisation of Technical Section

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT 9

Management of Hospital Organisation, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Team Work, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEALTH CARE CODES 9

FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.

UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT 9

Organising Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance.

UNIT V TRAINED TECHNICAL PERSONNEL 9

Function of Clinical Engineer, Role to be performed in Hospital, Manpower Market, Professional Registration, Structure in Hospital.

TOTAL = 45 PERIODS

REFERENCES

1. Cesar A.Caceres and Albert Zara,The Practice of Clinical Engineering, Academic Press, New York,1977.
2. Webster.J.G. and Albert M.Cook,Clinical Engineering Principles and Practices Prentice Hall Inc. ,Englewood Cliffs, New Jersey, 1979.
3. Hans Pfeiff,VeraDammann (Ed.),Hospital Engineering in Developing Countries, Z Report, Eschbom,1986
4. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. SanDeigo1988
   .
5. R.C.Goyal, Human Resource Management in Hospital, Prentice Hall of India, 3rd edition,2000.
6. Syed Amin Tabish “Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME063	WAVELET TRANSFORMS AND ITS APPLICATIONS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge wavelet transformation				
	Course Designed by : Electronic				

OBJECTIVES

1. To study the Series expansion of signals, Multi resolution concepts.
2. To know Impulse trains and Poisson sum formula, DFT, DTFT, DTFS.
3. To study the Analysis of multi channel and modulated filter banks.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Signal Processing – Continuous, Discrete and Multi rate discrete time signal processing **.**
CO2	Learn the Discrete time Wavelet series and properties.
CO3	To learn Properties of scaling function and wavelet.
CO4	To learn Approximation of scaling coefficients by sample of the signal and by scaling function projection.
CO5	Study the wavelet compression of medical images. Video compression, denoising and edge detection.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I FUNDAMENTALS OF SIGNAL DECOMPOSITIONS 9

Series expansion of signals, Multi resolution concepts – Hilbert spaces – Vectors space and inner products, complete inner product spaces, orthogonal and general

basis. Fourier theory and sampling – Fourier transform, Fourier series, direct function, Impulse trains and Poisson sum formula, DFT, DTFT, DTFS. Signal Processing – Continuous, Discrete and Multi rate discrete time signal processing. Time frequency representation.

UNIT II DISCRETE TIME BASIS AND FILTER BANKS 9

Series expansion of DTS – DTFS, Haar expansion of DTS, Sinc expansion of DTS. Tree – Structured filter banks – Octave-band filter bank, Discrete time Wavelet series and properties, Multi resolution, Interpretation, Wavelet packets. Multi channel filter banks – Block and lapped orthogonal transforms, Analysis of multi channel and modulated filter banks. Multi dimensional filter banks – Analysis and Synthesis.

UNIT III MULTI RESOLUTION CONCEPT AND MODULATED BASES 9

Multi resolution analysis – Wavelet function, DWT. bases, orthogonal basis and biorthogonal bases. Scaling function, scaling coefficients, Wavelet and wavelet coefficients – Scaling function and wavelet. Properties of scaling function and wavelet.Parameterization of scaling coefficients. Calculating the basic scaling function and wavelet. Local cosine bases – Rectangular window, smooth window and general window.

UNIT IV WAVELET SYSTEM DESIGN 9

Daubechie's method for zero wavelet moment design.Non-maximal regularity wavelet design.Relation of zero wavelet moments to smoothness, Approximation of scaling coefficients by sample of the signal and by scaling function projection. Tiling the time frequency and time scale plane.

UNIT V APPLICATIONS 9

Wavelet, wavelet packets and matching pursuits with bio medical applications – analysis of phono cardiogram signals, feature extraction for neuro physiological signals, speech enhancements for hearing aids. Wavelets in medical imaging – wavelets applied to mammograms, adapted wavelet encoding in fMRI, wavelet compression of medical images. Video compression, denoising, edge detection, and discrete wavelength multi tone modulation.

L =45 TOTAL = 45 PERIODS

REFERENCES

1. M.Vetterli and J. Kovacevic, 'Wavelets and sub band coding', Prentice Hall, 1995.
2. C.SidneyBurrus, Ramesh Gopinath&HaitoGuo, 'Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
3. MetinAkay, 'Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
4. Raguveer m Rao&Ajith S. Bopardikar, 'Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998
5. S.Mallet, 'A Wavelet tour of signal processing', Academic Press 1998

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME064	TELEHEALTH TECHNOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge about telemedicine				
	Course Designed by : Biomedical				

OBJECTIVES

1. To study the Series History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine.
2. To know Social and legal issues, Safety and regulatory issues and Advances in Telemedicine.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Tele health, Tele care and Organs of telemedicine**.**
CO2	Learn the Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications.
CO3	To learn Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN).
CO4	To learn Basic parts of teleradiology system.
CO5	Introduction to robotics surgery, tele surgery, Tele cardiology and Teleoncology.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M			H			M			H
CO2				H			M			M		
CO3		M			M	H		H	M			
CO4			M								H	M
CO5	H		M		M	M				M		

Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√		
Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario,

Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing.clinical data–

local and centralized

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available.Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology,
Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

L =45 TOTAL = 45 PERIODS

REFERENCES

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
4. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.

5. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
6. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)
7. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
8. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
9. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
10. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
11. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME057	REHABILITATION ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in artificial organs				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. To develop an understanding of the various rehabilitation aid principle and its working.
2. To give various information about rehabilitation medicine and Advocacy.

COURSE OUTCOMES (COs)

CO1	**CO01:**Design rehabilitation aid and apply them with confidence, to help the challenged people.
CO2	The rehabilitation process for people with disabilities often entails the design of assistive devices such as walking aids intended to promote inclusion of their users into the mainstream of society, commerce, and recreation.
CO3	Within the National Health Service of the United Kingdom Rehabilitation Engineers (REs) are commonly involved
CO4	This includes electrically powered wheelchairs, active user (lightweight) manual wheelchairs, and in more advanced clinics this may include assessments for specialist wheelchair control systems and/or bespoke seating solutions.
CO5	Learn about the technologies relating Rehabilitation Engineering

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I REHABILITATION TECHNOLOGY 9

Selection, design or manufacturing of augmentive or assistive devices appropriate for individual with disability

UNIT II REHABILITATION SCIENCE 9

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

UNIT III REHABILITATION ADVOCACY 9

Legal aspect helps the handicapped people in choosing the device, the provisions available to them in this regard.

UNIT IV REHABILITATION MEDICINE 9

Physiological aspects of functional recovery, neurological and psychological aspects, rehabilitation therapies, training to restore vision auditory and speech

UNIT V RÉHABILITATION ENGINEERING TECHNOLOGIES: PRINCIPLES OF APPLICATION 9

Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

Total = 45 PERIODS

REFERENCES

1. Reswick.J. What is Rehabilitation Engineering? ,Annual Review of rehabilitation Volume 2 Springer - Vorlage, New York, 1982.

Robinson.C.J, Rehabilitation Engineering, Handbook of electrical engineering, CRC Press, Bocaraton, 1993

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME065	DSP INTEGRATED CIRCUITS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge signal processing				
	Course Designed by : Electronic				

OBJECTIVES

1. To study Standard digital signal processors.
2. To know Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design**.**
CO2	Learn the Principles of Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm.
CO3	To learn FIR filters, FIR filter structures and FIR chips.
CO4	To learn DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors.
CO5	Study the Conventional number system, Redundant Number system, Residue Number System and Bit-parallel.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M			H			M			H
CO2				H			M			M		
CO3		M			M	H		H	M			
CO4			M								H	M
CO5	H		M		M	M				M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I DSP INTEGARTED CIRCUITS AND VLSI CIRCUIT TECHNOLOGIES 9

Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process

technologies, Trends in CMOS technologies.

UNIT II DIGITAL SIGNAL PROCESSING 9

Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal-processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.

UNIT III DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS 9

FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT IV DSP ARCHITECTURES AND SYNTHESIS OF DSP ARCHITECTURES 9

DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures. Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

UNIT V ARITHMETIC UNITS AND INTEGRATED CIRCUIT DESIGN 9

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolator as case studies.Cordic algorithm.

L = 45 TOTAL = 45 PERIODS

REFERENCES

1. Lars Wanhammer, “DSP Integrated Circuits”, 1999 Academic press, New York
2. A.V.Oppenheim et.al, “Discrete-time Signal Processing”, Pearson Education, 2000.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, “ Digital signal processing – A practical approach”, Second Edition, Pearson Education, Asia.
4. KeshabK.Parhi, “VLSI Digital Signal Processing Systems design and Implementation”, John Wiley & Sons, 1999.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME052	ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic electronic application				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

•To understand the significance of infections, biomedical waste and its proper disposal

• To teach the students about the controls applied to waste management.

COURSE OUTCOMES (COs)

CO1	What clinical engineering is all about and about hospital management
CO2	Types and importance of networking, different topologies and uses
CO3	Principles of fiber optic communication in hospital environment
CO4	Principles of EMI
CO5	Use of virtual environment in medicine

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

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

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I CLINICAL ENGINEERING **9**

Need for Standardization, Medical standards and recalibration,Hospital design, Hospital safety Regulations, hospital Management and Legal aspects.

UNIT II NETWORKING **9**

Importance of networking, types 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.

UNITIII 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 polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.

UNIT IV 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

UNIT V VIRTUAL REALITY APPLICATION **9**

Basic concepts of Virtual Environment , Human Factors and Human Perception, Computer graphics principles used in VR, Modeling of a Virtual Environment ,Existing tools, Avadars, Sensors for Perception, Tracking, Camera, Head mount display used in VR, Applications of Virtual Reality in Medicine

TOTAL = 45 PERIODS

REFERENCES

1. Syed Amin Tabish “Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
2. Jacob Kline – Handbook of Biomedical Engineering Academe press INC Sandiego 1981.
3. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech House 3rd Edition, 1986.
4. Eric Udd, Fibre Optic Sensors and introduction for engineers and scientists,WileyInterscience Publication, New Delhi, 1991.
5. SK Basandia, Local Area Network,Golgotia Publishing Pvt. Ltd., New Delhi, 1995

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME055	ADVANCED NEURAL COMPUTING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in neural networks				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- The course will teach a variety of contemporary approaches to neural networks and introduce the theory underlying these approaches.
- The approaches to be covered will include such things as biological and statistical foundations of neural networks, Perception, MLPs, RBFN,SVM and competitive learning.
- Additionally, a brief introduction to optimization techniques using Genetic algorithm and its applications will be given.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course student gains knowledge about various neural networks that can be used for biomedical signal analysis and Medical image analysis.
CO2	About the genetic algorithms as well as techniques used in its implementation.
CO3	Examinations of humans' central nervous systems inspired the concept of artificial neural networks.
CO4	Applications in ANN
CO5	Capability of approximating non linear functions of their

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M
	CO5	H				M	M				M	H	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I FUNDAMENTAL CONCEPTS AND MODELS OF ARTIFICIAL NEURAL SYSTEMS 9

Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II BPN AND BAM

Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory Definition, BAM, Hopfield Memory, Simulated Annealing-Boltzmann Machine.

UNIT III OTHER NETWORKS 9

Counter Propagation Network, Feature Mapping, Self Organising Feature Maps, Adaptive Resonance Theory (ART) Network Descriptions,

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 10

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling

UNIT V ADVANCES AND APPLICATIONS 8

Support Vector Machines, R B F Network, NeocognitronEvolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

TOTAL = 45 PERIODS

REFERENCES

1. Philip D.Wasermann, Advanced Methods in neural Computing, Van NostrandReinhold,NewYork 1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison - Wesley USA,1997.
3. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998. .
4. Simon Haykins, Neural Networks ,PrenticeHallinternationallnc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley,India 1999.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MBME066	BIO-MECHANICS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in tissue engineering				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

1. Introduction to bio-mechanics.
2. To know mechanical properties of soft biological tissues.

COURSE OUTCOMES (COs)

CO1	To learn Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity and non Newtonian viscosity**.**
CO2	Learn the Flow properties of blood, effect of shear rate. **CO03**- To learn Orthopedic biomechanics.
CO3	To learn Orthopedic biomechanics.
CO4	To learn Skeletal muscles servo mechanism.
CO5	Study the Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	H	L	M	M M	M					
CO2	M	L	H	L	M	M M	M					
CO3	M	L	H	L	M	M M	M					
CO4	M	L	H	L	M	M M	M					
CO5	M	L	H	L	M	M	M	M				

3 Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√	

4 Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INTRODUCTION **9**

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, mechanical properties of soft biological tissues.

UNIT II MECHANICS OF CIRCULATION **9**

Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III MECHANICS APPLIED TO ORTHOPAEDICS **9**

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, analysis of force in orthopedic implants.

UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS **9**

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION **9**

Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

TOTAL = 45 PERIODS

REFERENCES

1. Y.C.Fung, Biomechanics : Mechanical properties in living tissues, Springer Verlag, Newyork1981.
2. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
3. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.
4. Susan J.Hall , Basics Bio Mechanics 4th Edition, McGrawHill Publishing Co,2002.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		

MST070	RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge on Management				
	Course Designed by : Management				

OBJECTIVES

1. To Get adequate knowledge about research concepts
2. To describe mathematical modeling and simulation
3. To understand experimental modeling
4. To get knowledge about the interpretation of result

COURSE OUTCOMES (COs)

CO1	To describe research concepts.
CO2	To Get adequate knowledge about mathematical modeling
CO3	To describe experimental modeling
CO4	To understand analysis of results.
CO5	To know about report writing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			
	CO4			M								H	M
	CO5	H		M		M	M				M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

1. RESEARCH CONCEPTS **9**

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION **9**

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING **9**

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS **9**

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING **9**

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis", Himalaya Publication.
2. Schank Fr.,"Theories of Engineering Experiments", Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, "Design of Experiments", Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design", John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education", PHI Publication.
5. Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication
6. S. S. Rao, „Optimization Theory and Application", Wiley Eastern Ltd., New Delhi, 1996.

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Quiz	4	Alumni
5	Online Test		
6	End Semester Examinations		