ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. MEDICAL ELECTRONICS
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO I: To ensure that Graduates are professionally capable in Medical Electronics to solve problems in environmental, food, biochemical and biomedical engineering and technology.

PEO II: To enable graduates to communicate at technical levels and to serve as team members or leaders with good interpersonal skills.

PEO III: To enable graduates to acquire proficiency in the theory and practice of bio-techniques through life-long learning.

PEO IV: To enable graduates to recognize societal and industrial needs and work to develop and produce any product of the desired quality at a competitive cost.

PROGRAMME OUTCOMES (POs):

PO1: To Solve the real-life engineering problems by employing the knowledge and skills of Medical Electronics.

PO2: Ability to design and conduct experiments, as well as to acquire, analyze interpret and report experimental data

PO3: Ability to design biomedical engineering systems, components or processes to meet desired needs to provide for sustainable development.

PO4: Ability to use the current engineering techniques, skills and modern tools necessary for biomedical engineering practice.

PO5: Ability communicates effectively, not only with engineers but also with the society.

PO6: Ability to function effectively as a leader with management and entrepreneurship skills as well as an active member in a multi- disciplinary learns.

PO7: Understanding of and commitments to biomedical engineering professional and ethical responsibilities.

PO8: Understanding of the social, cultural and environmental responsibilities in global and local of a professional biomedical engineer.

PO9: Understanding and developing the competence for continuous learning in the area of design, Medical Image Processing and Radio Therapy.

PO10: Knowledgeable in current biomedical engineering issues.

PROGRAM SPECIFIC OBJECTIVES (PSOs):

PSO1: To acquire and understand the basic skill sets required for Medical Electronics Engineering.

PSO2: To implement the techniques and tools of Medical Electronics Engineering to address the needs of technology in healthcare domain.

PSO3: To address the problems associated with the interaction between living and non-living materials and systems.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

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

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
I	x	x	x							x
II	x	x			x	x	x		x	x
III		x	x	x			x	x		
IV			x	x	x	x	x	x	x	x

Year	Sem	Course Title	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I	1	Applied Mathematics for Medical Engineers	x									
	1	Human Anatomy and Physiology	x	x				x		x	x	x
	1	Medical Instrumentation		x	x	x				x	x	x
	1	Bio Signal Processing		x		x		x			x	
	1	Medical Equipments			x	x	x	x	x	x	x	x
	1	Professional Elective I										
	1	Medical Instrumentation Laboratory		x		x				x		x
I	2	Applied Medical Image Processing				x	x	x	x			x
	2	Medical Imaging and Radio Therapy		x		x		x		x	x	
	2	Biomechanics		x		x	x	x				x
	2	Health Care and Hospital Equipment Management		x		x	x	x				x
	2	Professional Elective II										
	2	Professional ElectiveIII										
	2	Data Acquisition and Processing Laboratory	x		x	x	x					x

II	3	Human Assist Devices		**x**		**x**	**x**	**x**				**x**
	3	Professional Elective IV										
	3	Professional Elective V										
	3	Hospital / Biomedical Industry Training		**x**		**x**	**x**	**x**		**x**	**x**	**x**
	3	Project Work Phase I			**x**			**x**	**x**	**x**	**x**	**x**
II	4	Project Work Phase II			**x**			**x**	**x**	**x**	**x**	**x**

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SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5157	Applied Mathematics for Medical Engineers	FC	4	4	0	0	4
2.	BM5151	Human Anatomy and Physiology	PC	3	3	0	0	3
3.	BM5191	Bio Signal Processing	PC	3	3	0	0	3
4.	MX5101	Medical Instrumentation	PC	3	3	0	0	3
5.	MX5102	Biomedical Equipments	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	MX5111	Medical Instrumentation Laboratory	PC	4	0	0	4	2
			TOTAL	**23**	**19**	**0**	**4**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM5291	Applied Medical Image Processing	PC	3	3	0	0	3
2.	MX5201	Medical Imaging and Radio Therapy	PC	3	3	0	0	3
3.	MX5202	Biomechanics	PC	3	3	0	0	3
4.	MX5203	Health Care and Hospital Equipment Management	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7.	MX5211	Data Acquisition and Processing Laboratory	PC	4	0	0	4	2
			TOTAL	**22**	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MX5301	Human Assist Devices	PC	3	3	0	0	3
2.		Professional Elective IV	PE	3	3	0	0	3
3.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	BM 5361	Hospital / Biomedical Industry Training	EEC	4	0	0	4	2
5.	MX5311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**25**	**9**	**0**	**16**	**17**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	MX5411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5157	Applied Mathematics for Medical Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5151	Human Anatomy and Physiology	PC	3	3	0	0	3
2.	BM5191	Bio Signal Processing	PC	3	3	0	0	3
3.	MX5101	Medical Instrumentation	PC	3	3	0	0	3
4.	MX5102	Biomedical Equipments	PC	3	3	0	0	3
5.	MX5111	Medical Instrumentation Laboratory	PC	4	0	0	4	2
6.	BM5291	Applied Medical Image Processing	PC	3	3	0	0	3
7.	MX5201	Medical Imaging and Radio Therapy	PC	3	3	0	0	3
8.	MX5202	Biomechanics	PC	3	3	0	0	3
9.	MX5203	Health Care and Hospital Equipment Management	PC	3	3	0	0	3
10.	MX5211	Data Acquisition and Processing Laboratory	PC	4	0	0	4	2
11.	MX5301	Human Assist Devices	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5361	Hospital / Biomedical Industry Training	EEC	4	0	0	4	2
2.	MX5311	Project Work Phase – I	EEC	12	0	0	12	6
3.	MX5411	Project Work Phase – II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*

SEMESTER I
ELECTIVE I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5093	Tissue Engineering	PE	3	3	0	0	3
2.	BM5071	Principles of Genetic Analysis	PE	3	3	0	0	3
3.	BM5072	Bio Materials	PE	3	3	0	0	3
4.	MX5091	Medical Ethics and Standards	PE	3	3	0	0	3

SEMESTER II
ELECTIVE II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5094	Biomedical Optics	PE	3	3	0	0	3
2.	MX5092	Bio MEMS	PE	3	3	0	0	3
3.	BM5073	Nano Technology and Applications	PE	3	3	0	0	3
4.	MX5071	Pattern Recognition Techniques and its Applications	PE	3	3	0	0	3

SEMESTER II
ELECTIVE III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MX5093	Computer Based Medical Instrumentation.	PE	3	3	0	0	3
2.	MX5001	Medical Informatics	PE	3	3	0	0	3
3.	CU5092	Real Time Embedded Systems	PE	3	3	0	0	3
4.	BM5391	Rehabilitation Engineering	PE	3	3	0	0	3

SEMESTER III
ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MX5072	Advanced Neural Computing.	PE	3	3	0	0	3
2.	CU5093	Wavelets Transforms and its Applications	PE	3	3	0	0	3
3.	MX5073	Physiological Modeling	PE	3	3	0	0	3
4.	BM5091	Bio Statistics	PE	3	3	0	0	3

SEMESTER III

ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5092	Brain Computer Interfaces	PE	3	3	0	0	3
2.	MX5094	Telehealth Technology	PE	3	3	0	0	3
3.	BM5075	Wearable Devices and Technologies	PE	3	3	0	0	3
4.	BM5074	Quality Assurance and Safety in Hospitals	PE	3	3	0	0	3

MA5157 APPLIED MATHEMATICS FOR MEDICAL ENGINEERS L T P C
4 0 0 4

OBJECTIVES :

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students in various engineering discipline. This course also will help the students to identify, formulate, abstract, and solve problems using mathematical tools from a variety of mathematical areas, including linear algebra, numerical solution of linear equations and differential equations, approximation of functions in terms of polynomials using interpolation, numerical differentiation and integration, linear programming and queueing models.

UNIT I VECTOR SPACE AND LINEAR TRANSFORMATION 12

Vector spaces – Subspaces – Linear spans – Linear independence and linear dependence – Basis and dimension – Linear transformation - Null space and range – Dimension theorem (no proof) – Matrix representation of linear transformation.

UNIT II NUMERICAL LINEAR ALGEBRA, INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Gauss elimination method - Gauss Jordan method – Jacobi, Gauss- Seidel iterative methods – Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation – Numerical differentiation by finite differences – Trapezoidal, Simpson's 1/3 and Gaussian quadrature formula.

UNIT III NUMERICAL SOLUTION OF ORDINANRY DIFFERENTIAL EQUATIONS 12

Numerical solution of first order ordinary differential equations by Taylor's series method – Euler's method - Fourth order Runge - Kutta method – Multistep methods : Adam's - Bash forth, Milne's predictor corrector methods - Finite difference methods for two point boundary value problems.

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation problems - Assignment models.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and multi server models – Little's formula - Machine interference model – Steady state analysis – Self service queue.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following topics:

- Compute basic objects associated with vector spaces and linear transformation.
- Solve an algebraic or transcendental equation, linear system of equations using an appropriate numerical method.
- Construction of an approximate polynomial using interpolation methods, finding of the derivatives and evaluation of integrals numerically.
- Numerical solution of ordinary differential equations using single and multistep methods.
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical knowledge, methodologies and modern computational tools.

REFERENCES :

1. Burden R. and Faires, J.D. “Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Friedberg, A.H., Insel, A.J. and Spence, L., “Linear Algebra”, Prentice Hall of India, New Delhi, 2004.
3. Gerald, C.F, and Wheatly, P.O., “Applied Numerical Analysis”, Pearson Education, New Delhi, 2002.
4. Jain, M.K, Iyengar, S.R.K, and Jain, R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003.
5. Kumaresan, S., “Linear Algebra – A Geometric Approach”, Prentice Hall of India, New Delhi, 2000.
6. Taha H.A., “Operations Research: An introduction”, 9th Edition, Pearson Education Asia, New Delhi, 2016

BM5151 HUMAN ANATOMY AND PHYSIOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION OF HUMAN BODY 8

Organization of human body, tissue and cavities – Anatomical planes, positions and sections -Cell: Structure and organelles structure – Functions of Each components in the cell. Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Recording of Action potentials, - Homeostasis

UNIT II BUILDING BLOCKS OF HUMAN BODY 8

Skeletal System: Bones, types and functions - Axial and Appendicular Skeleton. Joints: Definition, Types and functions. Cartilage: An overview - types and functions. Muscular System: Types of Muscle - Skeletal Muscle structure - Action potential and functions - Skin and Appendages.

UNIT III RESPIRATION, NUTRITION AND EXCRETORY SYSTEM 10

GI Tract: Organization of GI tract – Mouth, Pharynx, Esophagus, Stomach, Small Intestine and Large Intestine - Accessory Organs: Salivary glands, Liver, Pancreas, Gall bladder, Teeth and Tongue. Ingestion, Digestion and Absorption – Factors regulating Movements and Digestion in GI tracts. Respiratory System: The Nose, Pharynx, Larynx, Trachea, Primary Bronchi, Lungs – Mechanism of Breathing – Respiratory Volumes, Measurements and Artificial Respiration. Urinary System: Structure of Kidney, Nephron, Ureter and Urinary bladder. Urine formation and Micturition reflex.

UNIT IV CARDIOVASCULAR AND ENDOCRINE SYSTEM 9

Cardiovascular System: Blood vessel, Types and internal structure - Cardiac Muscle: Structure and Action potential – Structure and Components of Heart - Conducting System of Heart – Heart Sounds – Blood Pressure – Regulation of Blood Pressure and Measurements. Endocrine Hormone – General Action – Second Messenger – Anterior and Posterior Pituitary Gland Hormones.

UNIT V NERVOUS SYSTEM AND SPECIAL SENSES 10

Organization of Nervous system: Structure, Types and Properties of Neurons - Action potential of Neuron - Neuroglial Cells – Central Nervous System and Peripheral Nervous System organization – Brain, Lobes and Cortical Areas – Spinal cord arrangement and Plexus formation. Autonomic Nervous System: Divisions and control on each system - Reflex Mechanism. Special Senses: Structure of Eye and Ear - Errors of refraction and Correction. Conduction pathway of vision and Hearing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Qualitatively and quantitatively describe each system of the human body covered in this course: integumentary, skeletal, muscular, nervous, sensory, and endocrine and the components of these systems on the organ and cellular level.
- Apply this knowledge into biomedical engineering field.
- Integrate a basic knowledge of chemistry and biochemistry with human physiology

REFERENCES:

1. Elaine.N.Marieb, "Essential of Human Anatomy and Physiology", Eleventh Edition, Pearson Education, New Delhi, 2015.
2. Gary A.Thibodeau, Kevin T.Patton, "Anatomy & Physiology", 8th Edition, Mosby Publisher 2012.
3. Gibson.J., “Modern Physiology & Anatomy for Nurses”, Blackwell SC Publishing 1981.
4. Gillian Pocock& Christopher D.Richards, "The Human Body", Oxford University Press, 2009.
5. Guyton „Text book of Medical Physiology – WB Jaunder company Philadelphia - 13th edition 2015.
6. Tobin C.E., “Basic Human Anatomy”, McGraw – Hill Publishing Co., Ltd., Delhi 1997.

BM5191 BIO SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES

- It provides a solid foundation in advanced biomedical signaling and imaging systems including up-to-date coverage of commercially relevant topics.
- It focuses on biomedical signals, processing the signals, and validate the methods and results for optimization of clinical applications
- To introduce techniques for automated classification and decision making to aid diagnosis

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, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, 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 cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, 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 discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats and other biomedical applications

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, 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

OUTCOMES:

At the end of this course, the students should be able to:

- Carry out multivariate component analysis.
- Explain biosignal classification

REFERENCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002
3. P.Ramesh Babu, "Digital Signal Processing", Sixth Edition, Scitech publications, Chennai, 2014.
4. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
5. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley, IEEE Press, 2015.
6. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

MX5101 MEDICAL INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES:

- To understand the components of an medical instrument and different types of electrodes used.
- To gain knowledge of the different biopotential characteristics and recording methods used for various biosignals.
- To develop an understanding of the nonelectrical parameters measurements so as to enable to record various non electrical parameters.
- To learn the methods used for blood flow measurement.
- To study the measurement techniques used for measurement of biochemical parameters.

UNIT I BIOELECTRODES 9

Components of Medical Instrumentation –Origin of Bio potential: Action Potential - Electrode electrolyte interface, Half-cell potential, Polarisable and Non-polarisable electrodes - Skin electrode interface – Bio-electrodes: Surface-, Micro-. Needle electrodes - Equivalent circuits of electrodes – Biochemical-, and Transcutaneous- electrodes: pH, pO2, pCO2

UNIT II BIOAMPLIFIERS, BIOPOTENTIAL SIGNALS AND THEIR RECORDING 9

Bioamplifiers- Carrier Amplifier, - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier - Bioelectric signals (ECG, EMG, EEG, EOG & ERG) and their characteristics - Electrodes for ECG, EEG and EMG - ECG Machine - EMG machine – 10-20 electrodes placement system for EEG - EEG machine - Heart sound and characteristics, PCG

UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of Blood pressure – Direct Methods and Indirect Methods - Temperature - Respiration rate - Heart rate measurement - O2 , CO2 measurements, Respiratory volume measurement, BMR Measurement, Plethysmography technique, Detection of various physiological parameters using impedance technique.

UNIT IV BLOOD FLOW METER AND BLOOD CELL COUNTER 9

Cardiac output Measuring techniques – Dye Dilution method, Thermo dilution method, BP method - Blood Flow measuring Techniques: Electromagnetic Type - Ultrasound Blood Flow meter, Automatic Counting of RBC, WBC and Platelets.

UNIT V BIOCHEMICAL MEASURMENT TECHNIQUES 9

Chemical Fibro sensors, Fluorescence sensors - Glucose Sensor - Colorimeter, Spectro photometer, Flame photometer – Chromatography - Mass Spectrometer , auto analyser.

TOTAL: 45 PERIODS

OUTCOMES:

By the completion of this course the student will be able to

- Understand the origin of biopotentials and various bioelectrodes
- Analyze different biopotential characteristics and recording methods.
- Develop measurement systems for non electrical parameters measurements.
- Perform biochemical measurements

REFERENCES:

1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and sons, New york 1989
2. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology- Pearson Education 4th edition New Delhi 2001.
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
4. Richard S.Cobbold Transducers for Biomedical Measurements; Principle and applications- John Wiley and sons, 1992.
5. R. Anand Natarajan - Biomedical Instrumentation and Measurements- PHI Learning, New Delhi, 2nd edition, 2015.
6. Webster J.G Medical Instrumentation application and design, Wiley, 4th edition 2016.

MX5102 **BIOMEDICAL EQUIPMENTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn about cardiac care unit , pulmonary analyzers and aid equipments and their functions
- To understand the principle involved in physiotherapy and electrotherapy equipments
- To gain knowledge about instruments used to kidney and bones measurements
- To study about the instruments used for sensory measurements and be able to design sensors
- To provide latest knowledge of special medical assistive and therapeutic equipments.

UNIT I CARDIAC CARE UNIT AND PULMONARY ANALYSERS 9

Pacemakers – Need, different types, electrode types and placement, batteries for pacemakers. Defibrillators AC and DC defibrillators. Regulation of Breathing - Pulmonary gas flow measurements - Pulmonary volume measurements - Respiratory gas analyzers – Nitrogen Gas Analyzer, Oxygen Analyzer - Humidifier, Nebulizer – Ventilators - Anasthesia machine

UNIT II PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS 9

Tissue response -Short ware diathermy - Microwave diathermy - Ultrasonic therapy Unit - Electrotherapy - FES, TENS - Bladder stimulator - Lithotripter system - Extra corporeal Shock wave therapy- Electrical safety-IEC-60601 standard

UNIT III INSTRUMENTS DEALING WITH KIDNEY AND BONES 9

Regulation of Water and Electrolyte Balance – Artificial Kidney – Hemo dialysis - Crafts for dialysis - Peritoneal dialysis - Dialyzers – different types - BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT IV SENSORY INSTRUMENTATION 9

Basic Audiometer, Pure tone audiometer, Audiometer system Bekesy – Hearing Aids - Ophthalmoscope – Tonometer - Measurement of Basal Skin response and Galvanic skin response - Instruments for testing Motor responses - Biofeedback Instrumentation

UNIT V SPECIAL EQUIPMENTS 9

Endoscopy – Laparoscopy - Cryogenic Equipment - Automated drug delivery system – Components of drug infusion system – Implantable infusion systems. Biotelemetry and Multipatient telemetry.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the student will be able to

- Describe the working of the pacemaker, pulmonary analyzers and aid equipments and their functions
- Obtain knowledge on different physiotherapy equipments and instruments dealing with kidney and bones.
- Develop measurement systems for sensory parameter measurements.
- Familiar with the special therapeutic equipments available.

REFERENCES:

1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and sons, New york 1989
2. Joseph J Carr and John Brown – Introduction to Biomedical equipment Technology- Pearson Education 4th edition New Delhi 2001.
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
4. Richard S.Cobbold - Transducers for Biomedical Measurements; Principle and applications- John Wiley and sons, 1992.
5. R. Anand Natarajan - Biomedical Instrumentation and Measurements- PHI Learning, New Delhi, 2nd edition, 2015.
6. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999

MX5111 MEDICAL INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES :

- To record the different biopotential characteristics and understand their characteristics.
- To study the physiological parameters by performing measurements using suitable techniques.

LIST OF EXPERIMENTS

1. Recording of ECG in standard lead systems
2. Recording of Electromyogram and measurement of nerve conduction velocity.
3. Recording and analysis of EEG in time and frequency domains.
4. Design of preamplifier for acquiring bio signals
5. Acquisition of Heart sounds using PCG
6. Plotting of human auditory response using audiometer.
7. Measurement of blood flow velocity using ultrasound transducer.
8. Study of different types of muscle stimulator waveforms.
9. Measurement of respiratory parameters using spirometer
10. Measurement of Galvanic skin resistance
11. Performance and testing of surgical diathermy unit using diathermy analyser
12. Blood Pressure measuring techniques.
13. Glucose measurement using sensor

TOTAL: 60 PERIODS

OUTCOME:

Students acquire knowledge about recording of bioelectric potentials, various physiological measurements used in medical field.

BM5291 APPLIED MEDICAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To develop computational methods and algorithms to analyze and quantify biomedical data
- To understand the fundamentals of medical image processing techniques.

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 – DFT, DCT, KLT, SVD.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering, Color image enhancement. Image Restoration - degradation model, Unconstrained and constrained restoration, Inverse filtering- Wiener filtering

UNIT III MEDICAL IMAGE REPRESENTATION 9

Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio

UNIT IV MEDICAL 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

OUTCOMES:

- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy

REFERENCES:

1. Atam P.Dhawan, “Medical Image Analysis”, Wiley Interscience Publication, NJ, USA 2003.
2. Anil. K. Jain, “Fundamentals of Digital Image Processing”, Pearson education, Indian Reprint 2003.
3. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc.,New York,2004
4. Kavyan Najarian and Robert Splerstor, “Biomedical signals and Image processing”,CRC – Taylor and Francis,New York,2006
5. Milan Sonka et al, “IMAGE PROCESSING, ANALYSIS AND MACHINE VISION”, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6. R.C.Gonzalez and R.E.Woods, “Digital Image Processing”, Second Edition, Pearson Education, 2002.
7. Wolfgang Birkfellner, “Applied Medical Image Processing – A Basic course”, CRC Press, 2011.

MX5201 MEDICAL IMAGING AND RADIO THERAPY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the production of x-rays and its application in medical imaging.
- 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 understand the Radiation therapy techniques and also Radiation safety.

UNIT I X – RAYS AND COMPUTED TOMOGRAPHY 9

Principle and production of X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Digital Radiography, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, digital subtraction angiography, mammography, dental X- ray units. Computerised Axial Tomography, Principle, Detectors, image reconstruction, Spiral CT, 3D Imaging.

UNIT II EMISSION IMAGING 9

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Principle of PET and SPECT, PET/CT.

UNIT III MAGNETIC RESONANCE IMAGING 9

Principle of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI instrumentation, Magnets, gradient coils, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT IV ULTRASOUND IMAGING AND THERMOGRAPHY 9

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes-A, B & M, Principles and theory of image generation. Thermography- Principle, detectors and applications.

UNIT V THERAPY USING X – RAYS AND ISOTOPES 9

Direct and Indirect effects of high energy radiation, Units for radiation Exposure, 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

OUTCOME:

- Will obtain domain knowledge in understanding various Medical Imaging techniques and Therapeutic applications of Radiation.

REFERENCES:

1. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chich~ster, 1986.
2. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
3. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics, Churchill Livingston, 5th Edition.
4. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
5. Jerry L.Prince and Jnathan M.Links,‖ Medical Imaging Signals and Systems‖- Pearson Education Inc. 2006
6. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, Mc Graw Hill Publications,New York, 1995.
7. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.

MX5202 **BIOMECHANICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To get the clear understanding of application of mechanics in medicine.
- To study the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments,
- To gain necessary knowledge about accident and injuries.
- Introduction to basic structural analysis of medical implants

UNIT I INTRODUCTION 9

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues. biofluid mechanics. Steps in analyzing a biomechanical problem – Graphical methods – contact forces – resolution of forces

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 MECHANICAL PROPERTIES OF BONES 9

Bone structure & composition mechanical properties of bone, cortical and cancellous bones - Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons. Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis

UNIT IV MECHANICS OF THE JOINTS 9

Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Structure of the Tibio femoral joint, patello femoral joint, knee joint motion – flexion, extension, rotation, Arthro-kinematics, stabilization and its contributors, positioning of the knee joints, locking/unlocking mechanism, Q- angle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis.

UNIT V DESIGN OF MEDICAL IMPLANTS USING SOFTWARE 9

Importance of medical Devices, World Scenario, Design process & factors, Micro Engineering, Prototyping, Software based design of implants – MIMICS, CAD/CAM, Material Analysis, Finite Element Analysis in Orthopaedic Biomechanics – Introduction - Methology for the finite element analysis of biomechanical systems - How to generate finite-element-models of the implant-bone-compound - Application of the finite-element-method for preclinical analysis of an endo-prosthetic implant - Application to the behaviour of hip prostheses - Application to the lumbar spine - Application to splints for hand therapy

TOTAL : 45 PERIODS

OUTCOMES:

The study of mechanical properties of biological tissues and the properties of blood give us awide understanding about its structure and when it undergoes wear and when it fails so many precautions can be given by ourselves to elders. Introduction to FEM and its medical applications. Human body boundary conditions for implants design and analysis. The knowledge gained will be helpful in doing research in properties of hard tissues like bones and to generate a mathematical mode of bonestructure etc.

REFERENCES:

1. A Z Tohen and C T Thomas, Manual of Mechanical Orthopaedics
2. C.R Ethier and C.A.Simmons , Biomechanics from Cells to Organisms, Cambridge University Press,2007.
3. David Moratal, Finite Element Analysis, ISBN 978-953-307-123-7, 698 pages, Publisher: Sciyo, Published August 17, 2010
4. D N Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982
5. D.N. Ghista and Roaf, Orthopaedic Mechanics, Academic Press
6. D.Dawson & V.Wright, Introduction to Biomechanics of Joints and Joint Replacement
7. Subratapal ,Text book of Biomechanics, Viva Education Private Limited, 2009.
8. Susan J. Hall, Basics Bio Mechanics 7th Edition, McGraw-Hill Publishing Co, Newyork, 2007.
9. V.C. Mow and W. C. Hayes, Basic Orthopedic Biomechanics, Lippincott, Raven Publishers
10. Y. C. Fung, Biomechanics: Mechanical properties in Living Tissues, Second Edition, Springer Verlag, New York, 1993.

MX5203 HEALTH CARE, HOSPITAL AND EQUIPMENT MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

To develop an understanding of the various setups of hospital, health care codes and equipment management, so as to enable the student to work in the hospital environment.

UNIT I HEALTH SYSTEM 9

Health organisation of the country, the State, the Cities and the Region, Health Financing System, Health services, Functions of Hospitals, Types of Hospitals, Primary Health Care –An Introduction, Ambulatory care.

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 TRAINED TECHNICAL PERSONNEL 9

Function of Clinical Engineer, Role to be performed in Hospital, Manpower requirement for different types of hospitals, Professional Registration, Structure in Hospital.

UNIT V 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.

TOTAL : 45 PERIODS

OUTCOMES:

The students will be able to apprehend the organisation structure in hospitals, the duties of personnel & the health codes, the training required for technical work for equipment management.

REFERENCES:

1. Cesar A.Caceres and Albert Zara,The Practice of Clinical Engineering, Academic Press, New York,1977.
2. Hans Pfeiff,Vera Dammann (Ed.),Hospital Engineering in Developing Countries, Z Report, Eschbom,1986
3. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. San Deigo 1988
4. R.C.Goyal, Human Resource Management in Hospital, Prentice Hall of India, 3rd edition,2000.
5. Syed Amin Tabish —Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
6. Webster.J.G. and Albert M.Cook,Clinical Engineering Principles and Practices Prentice Hall Inc.,Englewood Cliffs, New Jersey, 1979.

MX5211	DATA ACQUISITION AND PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:

To study the various aspects of acquisition and analysis of bio signals and medical images
To understand the importance of electrical safety of medical equipments
To study practically the concepts of physiological modeling

LIST OF EXPERIMENTS

1. Acquisition and analysis of bio signals using workstation.
2. Study of auditory and visual evoked responses.
3. Development of software for basic telemedicine.
4. Development of neural network for signal classification.
5. Acquisition and analysis of medical images.
6. Development of software for medical image compression.
7. Development of algorithm for medical data security.
8. Study of IDL as a tool for medical image analysis.
9. Study of DICOM standards.
10. Study of lung and cardiovascular models.
11. Electrical safety testing of medical equipment.
12. Mini project (Should include hardware and software).

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to acquire and analyse any physiological signal and model the physiological systems
- Apply the techniques of medical image analysis and providing security to medical data

MX5301 **HUMAN ASSIST DEVICES** **L T P C**
3 0 0 3

OBJECTIVE:

The objective of this to know the principle, design and application of various human assist devices which includes extracorporeal devices, artificial heart, cardiac assist devices, respiratory devices and hearing aids .Additionally, a brief introduction to design aspects of prosthetic and orthotic devices for the disability will be given.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the 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 ORTHOTIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices

UNIT V RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-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

OUTCOMES:

At the end of this course the students will be able to

- Explain the role and importance of Heart lung machine and artificial Heart.
- Explain the importance of different types of assist devices and related issues.
- Ability to specify the type of assistive devices for rehabilitation.

REFERENCES:

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

BM5093 **TISSUE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand basics of Tissue Engineering
- To understand fundamentals of cell mechanisms
- To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
- To understand application of Tissue Engineering

UNIT I BASICS OF TISSUE ENGINEERING 9

Introduction to Tissue Engineering - Objectives of Tissue Engineering - Basic definitions - Structure and organization of Tissues – Development of Tissue – Tissue exchange and diffusion of simple metabolites – Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

UNIT II FUNDAMENTALS OF CELL MECHANISMS 9

Cell adhesion, Cell migration and Cell aggregation – Cell growth and Cell cycle. Cellular Interactions: Cell – Cell and Cell – Matrix. Control of Cell migration in Tissue Engineering –Cell delivery and Recirculation – Cell Culture in vitro – 3D culture in Tissue Engineering - In vitro Organogenesis - Cell transplantation.

UNIT III BIOMATERIALS IN TISSUE ENGINEERING 9

Definition – Biological vs Nonbiological materials – Extra Cellular Matrix – Collagen, Chitin & Degradable and Non degradable materials – Polymer, Ceramics and Metals – Cell interaction with different materials –- Scaffolds - Control releaser agents in Tissue Engineering – Cell interaction with suspension and gels – Tissue response to implants.

UNIT IV STEM CELLS IN TISSUE ENGINEERING 9

Introduction of Stem cells – Hemopoetic Stem cells - Embryonic Stem cells - Adult stem cells – Cancer Stem cells – Cord Blood cells – Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis – Differentiation, Dedifferentiation and Immortalization – Application of stem cells in tissue Engineering.

UNIT V TISSUE ENGINEERING APPLICATIONS 9

Synthetic components – Artificial organs – Joints and dental prostheses - Connective Tissue Engineering – Cardiovascular Tissue Engineering – Neural Tissue Engineering - Cell and Drug Delivery systems.

TOTAL : 45 PERIODS

OUTCOMES:

By successfully completing this course, students will be able to:

- Discuss the importance of tissue engineering in the field of biomedical engineering Explain the mechanisms involved in interaction of different materials with cells and tissues
- Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
- Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds
- Explain different types of stem cells and its application in tissue engineering
- Develop new approaches to build new tissues using tissue engineering techniques

REFERENCES:

1. Gary E Wnek, Gary L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York, 2nd edition, 2008.
2. Robert P. Lanza, Robert Langer and Joseph Vacanti., Principles of Tissue Engineering, 2nd Edition, Academic press, Elsevier 2013.
3. R.Lanza, J.Gearhart et.al,(Eds), Essential of Stem cell Biology, Elsevier Academic Press, 2nd edition 2009.
4. SujataV.Bhatt, Biomaterials (2nd Edition), Narosa Publishing House, 2005.
5. W. Mark Saltzman Tissue Engineering – Engineering Principles for Design of Replacement Organs and Tissue, Oxford University Press Inc. New York, 2004.

BM5071 PRINCIPLES OF GENETIC ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamental principles of genetics and to describe the experiments used to establish them.
- To develop skills in applying these principles to solve genetic problems and demonstrate how genetic analysis can be used to investigate aspects of biology.

UNIT I GENETIC INHERITANCE 9

Organisation of DNA, Chromosomal inheritance, Eukaryotic genomes – repetitive and non-repetitive sequence, Genetic mapping - restriction cleavage,RFLP and SNPs.

UNIT II DNA AND PHENOTYPE 9

DNA structure and replication, DNA sequencing, amplification and hybridisation. DNA Polymorphism, RNA transcription and processing, translation and its post translation modification. Regulation of gene expression.

UNIT III ENGINEERING OF GENES 9

Gene isolation and manipulation, mutations, repair and recombination, site directed mutagenesis, in vivo techniques of genetic manipulation, tools for analysing gene expression and genetically modified organisms.

UNIT IV HUMAN GENOME PROJECT 9

Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, physical mapping, gene ontology, gene annotation, techniques in HGP – microsatellite markers, STS, EST,DNA sequencing and DNA microarray, scientific & medical benefits of this project.

UNIT V IMPACT OF GENETIC VARIATION 9

Population Genetics, Quantitative Genetics, Evolution Genetics.

TOTAL : 45 PERIODS

OUTCOMES:

- Interpret different forms of inheritance patterns and identify them in genetic data
- Acquire in depth knowledge in evolutionary analysis of genetic sequence
- Interpret and critically evaluate the outcomes of statistical analysis associated with the research project
- Exploit relevant molecular genetic information with skill and confidence to conduct a research project involving the analysis of real molecular genetic data with minimal supervision

REFERENCES:

1. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley, Introduction to Genetics Analysis‖, – W.H Freeman & company, New York 11th Edition - 2015.
2. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten —Molecular Biotechnology, Principles and application of Recombinant DNA 4th Edition ASM Press, 2010.
3. Karp, Gerald - Cell and Molecular Biology. Concepts and Experiments, 7th Edition, John Wiley Sons, 2013.
4. Tom Strachan, Andrew P Read —Human molecular Genetics‖ 4th Edition, Garland Publishing – 2010.
5. Watson. J. etal, — Molecular Biology of the Gene —, 7th Edition, Pearson Publication, 2014.
6. Weaver. R.F. — Molecular Biology — 5th Edition, McGraw – Hill, 2011.

BM5072 BIO MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To introduce concepts of materials, surface and tissue placement in biomaterial functions
- To understand diverse elements controlling biological responses to materials
- To provide contemporary biomaterial principles

UNIT I INTRODUCTION 10

Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

UNIT II MATERIALS IN MEDICAL DEVICES 10

Metals, Ceramics, Polymers and Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERLIZATION OF BIOMATERIALS 7

Sterilization techniques: – process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gassterilization.

UNIT IV TESTING OF MATERIALS 8

Testing with Tissue Culture – in vitro and in vivo assessment of biocompatibility, testing with Soft Tissues and testing at non Thrombogenic surface – blood compatibility and thromobogenicity, ISO 10993- standard for assessment of biocompatibility.

UNIT V HARD AND SOFT REPLACEMENT 10

Cardiac Implants, Orthopedic Implants, Neuromuscular Implants, Transcutaneous Implants, Intraocular lenses.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Widen rational design approaches to biomaterials engineering Identify significant gap required to overcome challenges and further development
- Develop critical analyses of biomaterials through proposal writing and review.

REFERENCES:

1. Andrew F.VonRacum, Handbook Of Biomaterials Evaluation: Scientific, Technical And Clinical Testing Of Implant Materials, Second Edition, CRC Press, 1998.
2. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine, 3rd Edition, Elsevier Academic Press,2013.
3. J.H.U.Brown (Ed), Advances in Biomedical Engineering, Academic Press 1975.
4. JytteBrender. Handbook of Evaluation Methods for Health Informatics, Elsevier Academic Press: Burlington, MA, 2006.
5. Joseph D. Bronzino and Donald R. Peterson, The Biomedical Engineering Handbook", fourth edition, CRC Press Taylor & Francis, 2015.
6. Jacob Cline, Hand Book of Biomedical Engineering, Academic Press in Sandiego, 1988.
7. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
8. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, CRC Press, 2005.

MX5091 MEDICAL ETHICS AND STANDARDS L T P C
3 0 0 3

OBJECTIVES:

- Achieve familiarity with some basic ethical framework& understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- Students will be able to know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.

UNIT I INTRODUCTION TO MEDICAL ETHICS 8

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities ,The Doctor And The Patient, The Doctor And The Profession, Professional Independence, The Doctor And Society.

UNIT II ETHICAL THEORIES & MORAL PRINCIPLES 9

Theories-Deontology & Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Principles-Non- Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine

UNIT III HOSPITAL ACCREDITATION STANDRADS 9

Accreditation - JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards -Indian Perspective.

UNIT IV HOSPITAL SAFETY STANDARDS 10

Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT V MEDICAL EQUIPMENT SAFETY STANDARDS 9

General requirements for basic safety & essential performance of medical equipments.IEC 60601 standards- Base Standard-general requirement of electrical medical devices, Collateral Standards-EMC radiation protection &programmable medical device system, Particular Standards-type of medical device

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:

- Legal and professional guidelines for the health professions
- Public duties and consent
- Guidelines to obtain medical standards in hospitals

REFERENCES:

1. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada 2009.
2. Bioethics--An Introduction for the biosciences‖, 2nd edition 2008, Ben Mepham, Oxford.
3. Domiel A Vallero -Biomedical Ethics for Engineers‖, Elsevier Pub.1st edition, 2007.
4. Joint Commission Accreditation Standards for Hospitals ,2nd edition 2003.
5. NilsHoppe and JoseMiola - Medical law and Medical Ethics - Cambridge University Press-2014.
6. Robert M Veatch‖ Basics of Bio Ethics‖, Second Edition. Prentice- Hall,Inc 2003
7. Physical Environment Online: A Guide to The Joint Commission‘s Safety Standards is published by HCPro, Inc. 2010.

BM5094 BIOMEDICAL OPTICS L T P C
3 0 0 3

OBJECTIVES:

THE OBJECTIVES OF THIS COURSE ARE:

- To provide a possibility for the student to acquire knowledge about the physical properties of light and its impact and interaction with biological tissue in terms of optical properties, instrumentation in photonics, through the use and design of appropriate optical components
- To understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body.

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, opto-thermal interaction, fluorescence.

UNIT II INSTRUMENTATION IN PHOTONICS 9

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

UNIT III SURGICAL APPLICATIONS OF LASERS 9

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, Urology, Lasers in Neurosurgery, Laser Treatment of Breast Tumors, Therapeutic Applications of Lasers in Gastroenterology.

UNIT IV DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM, X-Ray Diagnostic Techniques, Speckle Correlometry, Near-Field Imaging in Biological and Biomedical Applications

UNIT V THERAPEUTIC APLLICATIONS 9

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications.

TOTAL: 45 PERIODS

OUTCOME:

Able to know the various optical properties of tissue as well as application of lasers in medical fields

REFERENCES:

1. Markolf H.Niemz, ―Laser-Tissue Interaction Fundamentals and Applications‖, Springer, 2007.
2. Mark E. Brezinski, ―Optical Coherence Tomography: Principles and Applications‖,Academic Press, 2006.
3. Paras N. Prasad, ―Introduction to Bio photonics, A. John Wiley and sons, Inc. Publications,2003.
4. R. Splinter and B.A. Hooper, ―An Introduction to Bio-Medical Optics‖, Taylor and Francis,2007.
5. Tuan Vo Dinh, ―Biomedical photonics – Handbook‖, CRC Press LLC, 2003.

MX5092 BIO MEMS L T P C
3 0 0 3

OBJECTIVES:

To understand

- Various MEMS fabrication techniques.
- Different types of sensors and actuators and their principles of operation at the micro scale level.
- Application of MEMS in different field of medicine.

UNIT I MEMS AND MICROSYSTEMS 9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining-photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor.

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers.

UNIT V APPLICATION OF BIO MEMS 9

CAD for MEMS, 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

OUTCOMES:

Students will be able to

- Understand the operation of different types of sensors and actuators at microscale level
- Understand the design issues at microscale level
- Choose the material for any application
- Apply the concepts to the design of different types of micro systems
- Apply the knowledge of CAD tools for MEMS design

REFERENCES:

1. Chang Liu, ‟ Foundations of MEMS‟, Pearson Education International, New Jersey, USA, 2006
2. Ellis Meng , —Biomedical Microsystems‖, CRC Press,Boca Raton, FL, 2011.
3. Marc J. Madou, Fundamentals of Microfabrication: the science of miniaturization ‘, CRC Press, 2002
4. NadimMaluf, Kirt Williams. —An introduction to Microelectromechancial Systems Engineering‖, Second Edition, Artech House Inc, MA, 2004
5. NitaigourPremchandMahalik, “MEMS”, Tata McGraw Hill Publishing Company, New Delhi, 2007
6. Tai Ran Hsu,“MEMS and Microsystems design and manufacture”, Tata McGraw Hill PublishingCompany, New Delhi, 2002
7. Wanjun Wang, Steven A.Soper “ BioMEMS- Technologies and applications”, CRC Press,BocaRaton,2007
8. Yang, Victor C., Ngo, That T, Biosensors and Their Applications, Springer, 2000.

BM5073 NANO TECHNOLOGY AND APPLICATIONS L T P C

3 0 0 3

OBJECTIVE:

- To know basic nanotechnological principles and characterization methods
- To understand the essential features of biology and nanotechnology that are converging to create the new areas of bionanotechnology and nanomedicine.

UNIT I INTRODUCTION OF NANOPARTICLES 9

Overview of nanotechnology from medical perceptive, different types of nanobiomaterials and nanostructure interactions. Synthesis, characterization, and properties smart nanomaterials, Surface modification, biofunctionalization of nanomaterials.Nanocarriers (e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, microemulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles)

UNIT II PROTEIN AS NANOSTRUCTURES 9

Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

UNITIII DNA AS NANOSTRUCTURES 9

DNA based nanostructures – Topographic and Electrostatic properties of DNA – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechanics

UNIT IV NANOPARTICLES IN DIAGNOSIS 9

Introduction to nanoparticles in diagnostics— nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials.

UNIT V NANOTHERAPEUTICS 9

Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, lung infectious disease, bone treatment, nano particles for oral vaccination and skin disease.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to:

- Follow the newest findings in the area of nanomedicine and implement the perspectives in own research.
- Explain nanoparticles in diagnosis
- Discuss nanotherapeutics

REFERENCES:

1. CM, Niemeyer,C.A. Mirkin., Nanobiotechnology – Concepts, Applications and Perspectives – 2004. Edited by Wiley – VCH.
2. Challa, S.S.R. Kumar, Josef Hormes, CarolaLeuschaer., Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. Wiley – VCH, 2005.
3. Harry F. Tibbals, Medical Nanotechnology and Nanomedicine, CRC Press, 2010.
4. Nicholas A. Kotov., Nanoparticle Assemblies and Superstructures, CRC, 2006.
5. T. Pradeep.,Nano: The Essentials: McGraw – Hill education – 2007.
6. VinodLabhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications of Nanotechnology, John Wiley & Sons, 2007.

MX5071 PATTERN RECOGNITION TECHNIQUES AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

- To know about Supervised and unsupervised Learning.
- To study about feature extraction and structural pattern recognition.
- To explore different classification models.
- To understand Fuzzy Pattern Classifiers

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering for unsupervised learning and classification – Clustering concept –Hierarchial clustering, Partitional clustering- k-means algorithm – Validity of Clusters.

UINT 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 HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V RECENT ADVANCES AND APPLICATIONS 9

Fuzzy logic – Fuzzy Pattern Classifiers – Case Study Using Fuzzy Pattern Classifiers CAD system in breast cancer detection, ECG signal classification, Fingerprint recognition, cell cytology classification

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to classify the data and identify the patterns

- Extract discriminatory features and select the features from given data set.

REFERENCES:

1. Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London,2002.
2. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3. Earl Gose, Richard Johnsonbaugh Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt Ltd., New Delhi, 1996.
4. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
5. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001
6. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
7. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press, 2008.

MX5093 COMPUTER BASED MEDICAL INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES:

- To teach PC hardware and its related interfacing
- To give a complete overview of 80186, 80286, 80386 and 80486 microprocessors.
- To understand the basics of computerized data acquisition and programming.
- To enrich the students knowledge with biometrics and network security.

UNIT I PC HARDWARE AND OVERVIEW 9

System Unit - Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply - BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics - Memory and I/O map

UNIT II PERIPHERAL INTERFACING AND CONTROLLERS 9

Keyboard and Mouse Interfaces - Memory types - RAM - SDRAM and RDRAM, Cache memory, ROM and its types, Flash memory, CMOS semiconductor memory - Adapter Cards - Sound Card, Modem card, Video card, Network Card - I/O slots - ISA, PCI and AGP bus slots - Ports - Serial and Parallel ports, USB, FireWire port, MIDI, SCSI, IrDA, Bluetooth – Connectors - System Bus, ISA, EISA, PCI, AGP and PCI bus - Disk controllers

UNIT III PROCESSORS AND MEMORY 9

80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards

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 - DSP in Medical applications

UNIT V CAD IN MEDCAL INSTRUMENTATION 9

FPGA Design Logics - Virtual Bio- Instrumentation in LAB view - Multisim Simulation with bio- amplifiers - Mixed signal SoC applications in biomedical application.

TOTAL :45 PERIODS

OUTCOMES:

- Exposed to PC hardware as well as various microprocessor family
- Hardware behind data acquisition
- Scope of virtual reality in health care
- Develop an insight knowledge about the biometrics and network security

REFERENCES:

1. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata
3. McGraw Hill Publishing Company, New Delhi, 2005
4. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
5. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
6. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
7. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007
8. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata Mc Graw Hill Publishing Company, New Delhi, 2005
9. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
10. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

MX5001 MEDICAL INFORMATICS L T P C

3 0 0 3

OBJECTIVE

- To study the modern healthcare data standards
- To understand the use of latest technology to share medical records

UNIT I MEDICAL INFORMATICS 9

Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Medical Informatics and its six levels of interfaces - Hardware and software requirements, Virtual Hospital, e – health services - Body Area Networks - Health Grid

UNIT II MEDICAL DATA AND STANDARDS 9

Electronic Patient Record (EPR) - Integrated clinical data - Biosignal and Medical image formats - Medical data storage and retrieval techniques – Steganography, - Medical Standards – HL7 – DICOM - IEEE 1073 - IRMA - LOINC - ICD10 - Medical standard organizations

UNIT III DECISION MAKING 9

Fuzzy logic – its applications in Medicine, Physiological System Modeling and Simulation, Virtual Reality and Multimedia Applications in Medicine, Biometrics - Biometric Devices - Physiological Characteristic Devices - Behavioral Characteristic Devices - Feature extraction and Decision making- Social issues

UNIT IV JAVA PROGRAMMING 9

Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL

UNIT V INTERNET AND WEB 9

Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine

TOTAL: 45 PERIODS

OUTCOMES:

The student understands the various aspects of informatics applied in health industry so that quality of health care is improved

REFERENCES:

1. Alain Venot -Medical Informatics, e-Health, Fundamental and Applications, Springer-Verlag Paris, 2013.
2. A S Godbole A Kahate, -Web Technologies, TCP/IP to Internet Application Architectures‖, TMH 2007.
3. Deitel, -Java How to Program‖, Pearson Education / PHI, 2006.
4. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
5. Keng ong, Medical Informatics - An execitive Primier, HIMSS, 2011
6. Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
7. Medical Informatics : Practical Guide for Healthcare and Information Technology Professionals, Lulu.com
8. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
9. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006

CU5092 REAL TIME EMBEDDED SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To study the basic concepts of ARM processors
- To understand the computing platform and design analysis of ARM processors
- To study the concepts of Operating systems in ARM
- To study the concept of embedded networks
- To understand case studies related to embedded systems

UNIT I INTRODUCTION TO ARM PROCEESORS 9

Fundamentals of ARM, ARM Instruction set, Thumb Instruction set, ARM assembly language programming, Digital Signal Processing in ARM, Exceptions & Interrupt Handling.

UNIT II COMPUTING PLATFORM AND DESIGN ANALYSIS 9

CPU buses – Memory devices – I/O devices – Memory Protection Units – Memory Management Units – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

UNIT III PROCESS AND OPERATING SYSTEMS 9

Multiple tasks and multi processes – Processes – Context Switching – Scheduling policies - Multiprocessor – Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes – Firmware and Operating Systems for ARM processor.

UNIT IV HARDWARE ACCELERATES & NETWORKS 9

Accelerators – Accelerated system design – Distributed Embedded Architecture – Networks for Embedded Systems – Network based design – Internet enabled systems.

UNIT V CASE STUDY 9

Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the student should be able to:

- Revise computing platform and design analysis
- Demonstrate multiple tasks and multi processes
- Discuss hardware and software co-design.

REFERENCES:

1. Andrew N Sloss, Dominic Symes and Chris Wright, “ARM system developer’s guide – Designing and Optimizing System Software”, Morgan Kaufmann publishers, 2004.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, dreamtech press, 2005.
4. Tim Wilmshurst, “An Introduction to the Design of Small Scale Embedded Systems”, Pal grave Publisher, 2004.
5. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Morgan Kaufmann Publisher, 2006.

BM5391 REHABILITATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To develop an understanding of the various rehabilitation aids so as to enable the student to design and apply them with confidence, to help the challenged people.

UNIT I INTRODUCTION TO REHABILITATION 9

Definition, Concept of Rehabilitation: Types of Physical Impairments**, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles,** Engineering Concepts in Sensory & Motor rehabilitation.

UNIT II ORTHOTICS & PROSTHETICS IN REHABILITATION: 9

Types of orthosis-FO,AFO,KAFO,HKAFO and prosthesis ,Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses, Prosthetic Hand, Advance and automated prosthetics and orthosis, Externally powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking.

UNIT III MOBILITY AIDS: 9

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair, Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches.

UNIT IV AUDITORY AND SPEECH ASSIST DEVICES: 9

Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer

UNIT V SENSORY AUGMENTATION AND SUBSTITUTIONS: 9

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired

TOTAL:45 PERIODS

OUTCOMES:

The student will have the knowledge about various rehabilitation aids available and the issues associated with the use of these aids

REFERENCES:

1. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
2. MacLachlan M. and Gallagher P. Enabling Technologies – Body Image and Body Function, Churchill Livingstone, 2004.
3. Mann W.C. (ed). Smart Technology for Aging, Disability, and Independence – The State of The Science, Wiley, New Jersey, 2005.
4. Muzumdar A. Powered Upper Limb Prostheses – Control, Implementation and Clinical Application. Springer, 2004.
5. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francics ,CRC press,2006

MX5072 ADVANCED NEURAL COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To learn the theory and implementation of neural networks
- To introduce neural computing as an alternative knowledge acquisition/representation paradigm,
- To explain its basic principles and their relationship to neurobiological models,
- To describe a range of neural computing techniques and their application areas.

UNIT I BASIC CONCEPTS OF NEURAL COMPUTING 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 9

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

UNIT III OTHER NEURAL NETWORKS 9

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

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 9

Genetic Algorithm: Fundamentals of genetic algorithm-Mathematical foundations-Genetic modeling-Survival of the fittest - crossover- Inversion and Deletion-mutation-reproduction Generational cycle-rank method-rank space method- Other derivative free optimization simulated annealing- Random search- Downhill simplex search- Applications.

UNIT V ADVANCES AND APPLICATIONS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Able to demonstrate an understanding of the principles of Neural Networks and a knowledge of their main areas of application;
- Ability to design, implement and analyse the behaviour of simple neural networks.
- Ability to use a neural network to solve real-world problems,

REFERENCES:

1. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison – Wesley USA, 1997.
2. Jang J.S.R., Sun C.T and Mizutani E, “Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence”, Prentice Hall, 1997.
3. James A Freeman and David M.Skapra, Neural Networks, Addison – Wesley, India 1999.
4. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998.
5. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold, Newyork 1993.
6. Simon Haykins, Neural Networks, Prentice HallinternationalInc, 1999.

CU5093 WAVELET TRANSFORMS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I INTRODUCTION TO WAVELETS **9**

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM **9**

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN **9**

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES **9**

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V WAVELET APPLICATIONS **9**

Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

TOTAL: 45 PERIODS

OUTCOME:

The students will be able to apprehend the detailed knowledge about the Wavelet transforms & its applications.

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, ‗Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
2. G.Strang and T.Nguyen, ‗Wavelet and filter banks', Wesley and Cambridge Press
3. M.Vetterli and J. Kovacevic, ‗Wavelets and sub band coding', Prentice Hall, 1995.
4. Metin Akay, ‗Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
5. P.P.Vaidyanathan, ‗Multi rate systems and filter banks', Prentice Hall 1993
6. Raguveer m Rao & Ajith S. Bopardikar, ‗Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998
7. S.Mallet, ‗A Wavelet tour of signal processing', Academic Press 1998

MX5073 **PHYSIOLOGICAL MODELING** **L T P C**
3 0 0 3

OBJECTIVES:

To understand and appreciate the value and application of

- Physiological models, 2.Vital organs 3. Modeling dynamically varying physiological system 4. Methods and techniques to analyze and synthesis dynamic models 5. Develop differential equations to describe the dynamic models, simulate and visualize dynamic responses of physiological models using software.

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

OUTCOME:

The student will have knowledge in the analysis of any physiological systems through the models

REFERENCES:

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

BM5091 **BIO STATISTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce strengths and limitations of measures of central tendency and measures of variability.
- To classify common statistical tests and tools.
- To distinguish between p-values and confidence intervals as measures of statistical significance.
- To interpret commonly used regression analysis.
- To evaluate commonly used statistical and epidemiologic measures.

UNIT I INTRODUCTION **9**

Introduction to probability, likelihood & odds, distribution variability.

UNIT II STATISTICAL PARAMETERS **6**

Statistical parameters p-values, computation and level chi square test and distribution.

UNIT III REGRESSION ANALYSIS **6**

Regression, correction use of regression, multiple regression.

UNIT IV INTERPRETING DATA **12**

Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V META ANALYSIS **12**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis

TOTAL: 45 PERIODS

OUTCOMES:

- The student is able to explain the techniques used in statistical & regression analysis. Also the student is able to compare the various parameters used in statistical significance.

REFERENCES:

1. Beth Dawson, Robert G. Trapp,Basic and clinical Biostatistics, McGraw Hill, 2004.
2. Joseph A. Ingelfinger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware Biostatistics in Clinical Medicine (third edition), Singapore, 1994.
3. John C. Bailar, David C. Hoaglin, Medical Uses of Statistics, 2012, Wiley.

BM5092 **BRAIN COMPUTER INTERFACE** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I INTRODUCTION TO BCI **9**

Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Could Anyone Use a BCI?, Non-invasive and Partially invasive BCI- Brain signal acquisition, Signal Preprocessing, Artifacts removal

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric andmagnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm,Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential – VisualEvoked Potential - Activity of Neural Cells - Multiple Neuro-mechanisms

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpassfiltering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression –Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V APPLICATIONS OF BRAIN-COMPUTER INTERFACES 9

Introduction, - BCIs for Assistive Technology – BCIs for Recreation - BCIs for Cognitive Diagnostics and Augmented Cognition - Rehabilitation and Prosthetics, Functional Near-Infrared Sensing (fNIR) and Environmental Control Applications - Near Infrared Sensing Technology – The OTIS System – Basic BCI Application – Environmental Control with fNIR, Brain-Computer Interfacing and Games – Introduction - Human-Computer Interaction for BCI - BCI for Controlling and Adapting Games, Direct Neural Control of Anatomically Correct Robotic Hands, Software Tools for BCI Research - Introduction – Data Streaming – Online DataProcessing - Ethical Issues in BCI Research.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

- Acquire the brain signal in the format required for the specific application
- Preprocess the signal for signal enhancement
- Extract the dominant and required features
- Classify the signal for applications

REFERENCES:

1. Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition, 2002.
2. Bishop C.M, “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.
3. Carlo Tomasi, “Estimating Gaussian Mixture Densities with EM – A Tutorial”, Duke University, 2000.
4. Desney S. Tan Anton Nijholt, Brain-Computer Interfaces - Applying our Minds to Human-Computer Interaction, Springer-Verlag London Limited 2010, ISSN 1571-5035, ISBN 978-1-84996-271-1.
5. Jonathan Wolpaw and Elizabeth Winter Wolpaw, Brain–Computer Interfaces: Principles and Practice, Published to Oxford Scholarship 2012, Print ISBN-13: 9780195388855
6. Jose del R. Millan et al, “Non-invasive brain actuated control of a mobile robot by human EEG”, IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
7. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981. ArnonKohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, ocaRato, Florida.
8. R. Dugad, U.B Desai, “A Tutorial on Hidden Markov Modeling”, Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
9. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
10. S. Coyle, T. Ward et al, “On the suitability of near infra-red systems for next generation Brain Computer interfaces”, Physiological Measurement, 25, 2004.

11. TorstenFelzer, “On the possibility of Developing a Brain Computer Interface”, Technical Report, Technical University of Darmstadt, Germany, 2001.
12. Wolpaw J. R, N.Birbaumer et al, “Brain control interface for Communication and control”, Clinical Neurophysiology, 113, 2002.
13. http:://ida.first.fhg.de/projects/bci/competition_iii

MX5094 TELEHEALTH TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To teach the key principles for telemedicine and health.
- To enable the students with the knowledge of telemedical standards, mobile telemedicine and its applications.

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, RealtimeTelemedicine 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

TOTAL : 45 PERIODS

OUTCOMES:

The student is exposed to the

- Technologies applied in multimedia using telemedicine
- Protocols behind encryption techniques for secure transmission of data.
- Applications of telehealth in healthcare

REFERENCES:

1. Bernard Fong, A.C.M. Fong, C.K. Li, Telemedicine Technologies: Information Technologies in Medicine and Telehealth, wiley, 2011.
2. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0).
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BM5075 WEARABLE DEVICES AND TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic principles of Wearable Physiological Monitoring Systems
- To Study various types of wearable systems
- To Learn to design sensors/electrodes for recording various vital parameters
- To Learn to design a wearable computer & Wireless Body Area Networks

UNIT I INTRODUCTION 9

What is Wearable Systems, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Recent developments – Global and Indian Scenario, Types of Wearable Systems, Components of wearable Systems, Physiological Parameters commonly monitored in wearable applications, Smart textiles, & textiles sensors, Wearable Systems for Disaster management, Home Health care, athletes, Sleep Apnea Monitoring.

UNIT II SMART SENSORS & VITAL PARAMETERS 9

Vital parameters monitored and their significances, Bio-potential signal recordings (ECG, EEG, EMG), Dry Electrodes design and fabrication methods, Smart Sensors – textile electrodes, polymer electrodes, non-contact electrodes, MEMS and Nano Electrode Arrays, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters.

UNIT III TECHNOLOGIES USED FOR A WEARABLE DEVICE 9

Students will comprehend the functions and very basic principles of different sensors, micro-motors and communication channels that are used in wearable devices. These include accelerometers, optical sensor, GPS, various input methods, Power Requirements, Wearable Systems Packaging, Batteries and charging, Wireless Communication Technologies and Protocols, Receiver Systems (Redrafting may be needed)

UNIT IV WIRELESS BODY AREA NETOWRKS 9

Wireless Body Area Networks – Introduction, Personal Area Networks (PAN), Application in Vital Physiological Parameter monitoring, Design of Sensor & Sink Nodes, Architecture, Communication & Routing Protocols, Security, Power and Energy Harvesting, Mobile Applications based devices.

UNIT V DATA PROCESSING AND VALIDATION 9

Classification Algorithms, Data Mining and Data Fusion, Signal Processing Algorithms in wearable Applications, Issues of wearable physiological monitoring systems, Statistical Validation of Parameters, Certifications of Medical Devices and Patenting.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, students should be able to:

- Explain the basics of wearable system
- Use smart sensors to monitor vital parameters
- Design wireless body area networks
- Apply classification algorithms

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BM5074 QUALITY ASSURANCE AND SAFETY IN HOSPITALS L T P C
3 0 0 3

OBJECTIVES:

- To provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care .
- To make the students aware of the role of biomedical engineer in hospitals, especially in the management of electrical supply, maintenance of electrical safety.

UNIT I STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 9

Define Quality- Need for Standarization & Quality Management**,** TQM in Health care organization- Quality assurance methods ,QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments

UNIT II REGULATORY REQUIREMENT FOR HEALTH CARE 9

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

UNIT III HOSPITAL SAFETY 9

Security & Safety of Hospital -Property, Staff & Patients**,** Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste.

UNIT IV ELECTRICAL & FIRE SAFETY 9

Sources of shocks, macro & micro shocks -Hazards, monitoring and interrupting the Operation from leakage current- Elements of fire, causes of fire , Action to be taken in case of fire in a Hospital.

UNIT V ASSESSING QUALITY HEALTH CARE 9

Patient Safety Organization- Governmental & Independent,Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction. 5S techniques

TOTAL :45 PERIODS

OUTCOMES:

The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals.

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