

M.TECH. BIO-MEDICAL INSTRUMENTATION - FULL TIME

Course Code	Course Title	L	T	P	O
SEMESTER NO. 1					
MMA101	Applied Mathematics for Electronics Engineers	4	0	0	4
MBI101	Biomedical Instrumentation	3	0	0	3
MBI103	Bio Signal Processing	3	0	0	3
MBI105	Anatomy and Physiology	3	0	0	3
MBI107	Radiological equipments	3	0	0	3
MMG131 A	Engineering Management	3	0	0	3
		19			

SEMESTER NO. 2

MBI202	Bio-Medical Equipments & Devices	3	0	0	3
MBI204	Laser & ultrasonic Applications in medicine	3	0	0	3
MBI206	Medical Image Processing	3	0	0	3
MBI208	Computer based Medical Instrumentation	3	0	0	3
- - -	Elective I	3	0	0	3
MBI210	Biomedical Engg. Lab	0	0	4	2
		17			

SEMESTER NO. 3

- - -	Elective II	3	0	0	3
- - -	Elective III	3	0	0	3
- - -	Elective IV	3	0	0	3
- - -	Elective V	3	0	0	3
MBI301	Project Preliminary & Mini Project	0	0	12	6
		18			

SEMESTER NO. 4

MBI402	Project Work (Pre-requisite Summer Practical Training)	0	0	36	18
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Total no. of credits to be earned for the Award of Degree **72**

ELECTIVES FOR M.E. MEDICAL ELECTRONICS

Course Code	Course Title	L	T	P	O
Lecture based courses					
MBIE01	Human Assist Devices	3	0	0	3
MBIE02	Advanced Neural Computing	3	0	0	3
MBIE03	Health, Hospital and Equipment Management	3	0	0	3
MBIE04	Medical Informatics	3	0	0	3
MBIE05	Rehabilitation Engineering	3	0	0	3
MBIE06	Recent advances applied to Hospital engineering	3	0	0	3
MBIE07	System theory applied to Bio-Medical Engineering	3	0	0	3
MBIE08	Biological effects of Radiation	3	0	0	3
MBIE09	Patter Recognition and AI Application	3	0	0	3
MBIE10	Special transducers and Instrumentation	3	0	0	3
MBIE11	Special Elective	3	0	0	3

MMA101 **APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS** **4** **0** **0** **4**

RANDOM PROCESSES: **9**

Random variables – Density & Distribution functions – Moments – Moment generating functions – Two Dimensional Random variables – Marginal and conditional Distributions – Random processes – Stationary & Ergodic Processes – Auto Correlation – Cross Correlation – Properties – Power Spectral Density.

SPECIAL FUNCTIONS: **9**

Series solutions – Bessel's equation – Bessel's Functions – Legendre's equation – Legendre polynomials – Rodriguez's formula – Recurrence relations – Generating functions and orthogonal property for Bessel functions of the first kind .

CALCULUS OF VARIATIONS: **9**

Introduction – Euler's Equations – Functional dependent on first & second derivatives – Brachistochrone problem – Functional involving two or more dependent variables – Isoperimetric problems – Variational methods of solving partial differential equations – Rayleigh-Ritz Methods – Kantorovich methods.

LINEAR INTEGRAL EQUATIONS: **9**

Different types of Integral equations – Fredholm & Volterra Integral equations – Relation between Differential & Integral equations – Green's functions – Fredholms equation with separable Kernel – Iterative methods for solving equations of second kind – Properties of symmetric Kernel.

INTRODUCTION TO FINITE ELEMENT METHODS:**9**

Introduction – FEM functions – Base functions – Methods of approximation – Rayleigh – Ritz method – Galerkin Method – Application to one dimensional & two dimensional problems.

REFERENCES:

1. Peebles Jr, P. Z., Probability, Random Variables & Random Signal Principles, 3rd Edition, McGraw Hill 1993.
2. Papoulis, Probability, Random Variables & Stochastic Processes, McGraw Hill 1991.
3. N. Narayanan, T.K. Manickvachagam Pillai and G. Ramanaiah – Advanced Mathematics for Engineering Students Vol. II, S. Viswanathan Pvt. Ltd., 1986.
4. Elsgolis. L., Differential equations and calculus of variations, Mir publishers, 1971.
5. Petrovsky, I. G., Lectures on theory of integral equations, Mir Publishers, 1971.
6. Sastry, S. S., Introductory methods of numerical analysis, PHI, New Delhi, 1999.
7. L. A. Andrews, Special function for scientists and Engineers, McGraw Hill, 1992.

MBI101**BIOMEDICAL INSTRUMENTATION****3****0****0****3****BIO-AMPLIFIERS AND ELECTRODES****6**

Necessity for low – noise pre-amplifiers, differences amplifiers, chopper amplifiers. Different types of electrodes, equivalent circuits of micro electrode.

BIO-POTENTIAL RECORDING**10**

ECG, EEG, EMG, PCG, EOG –lead system and recording methods, typical waveforms, frequency spectrum, abnormal waveforms, evoked response.

IMPEDANCE TECHNIQUES**8**

Bipolar and tetra polar circuits, detection of physiological activities using impedance techniques, GSR., cardiac output, neural activities, respiratory activity, impedance plethysmography – resistance and capacitance type.

NON – ELECTRICAL PARAMETERS AND RESPIRATORY MEASUREMENTS**8**

Respiration, heart rate, temperature, blood pressure, O₂, CO₂ measurements, Spiro meter, BMR apparatus.

BLOOD FLOWMETERS AND BLOOD CELL COUNTING**6**

EM and ultrasonic blood flow meters indicator dilution method, Thermo dilution method, Manual and Automatic Counting of RBC, WBC and Platelets – Auto analyzer

BIO-CHEMICAL MEASUREMENTS**7**

pH, pCO₂, pO₂, pHCO₃ electrophoresis, colorimeter, spectrophotometer, flame photometer.

REFERENCES:

1. Geddes L.A. and Baker L.E., Principles of applied biomedical Instrumentation, John Wiley and Sons, New York, 1975.
2. Harry E. Thomas, Handbook of Automated Electronic Clinical Analysis, Reston Publishing Company, Virginia, 1979.
3. Heinix Kresse, Handbook of Electro medicine, John Wiley and Sons, Chichester, 1985.
4. Richard A. Normann, Principle of Bio Instrumentation, John Wiley and Sons New York, 1988.
5. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Company, New Delhi, 1999.
6. Webster J.G., Medical Instrumentation, John Widly and sons, New York, 3rd edition, 1999.
7. John Enderle Susan M. Blanchard, Joseph Brozino, Introduction to Biomedical Engineering, Academic press, Sandiego, 1999.

MBI103**BIO-SIGNAL PROCESSING****3****0****0****3****SIGNAL, SYSTEM AND SPECTRUM****10**

Characteristics of some dynamic biomedical signals – bioelectric signals, impedance., acoustic signals, mechanical signals biomagnetic signals, biochemical signals. Signal conversion-simple signal conversion systems, conversion requirements for bio-medical signals. Basics of digital filtering – FIR and IIR filters. Spectral analysis – power spectral densities function, cross-spectral density and coherence function, cepstral analysis and homomorphic filtering. Estimation of Mean of finite time signal.

TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION**7**

Time series analysis – linear predication models, process order estimation, lattice representation, non-stationary process, adaptive segmentation, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model simulator.

ADAPTIVE FILTERING AND WAVELET DETECTION**8**

Filtering – LMS adaptive noise canceling in ECG, improve adaptive filtering in FECCG. Wavelet detection in ECG-structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

BIOSIGNAL CLASSIFICATION AND RECOGNITION**10**

Signal classification and recognition – statistical signal classification, linear discriminate function, direct features selection and ordering, Back Propagation Neural network based classification.

SELECTED TOPICS IN BIOSIGNAL PROCESSING**10**

Application of wavelet transform on Biosignal –TFR representation, ECG data compression, ECG characterization. Application of Chaos theory on Biomedical signals. Software implementation of signal processing algorithms on biomedical signals

REFERENCES:

1. Wills J Tompkins, Biomedical Digital Signal Processing Prentice Hall, New Jersey, 1993.
2. Samuel D. Stearns Ruth A. David, Signal Processing algorithms using Fortran and C, Prentice Hall, New Jersey, 1993.
3. Vallaru Rao and Hayagriva Rao, C++ Neural Networks and fuzzy logic, BPS Publication, New Delhi, 1996.
4. Special topics on The applications of chaos theory on Biosignal, Journal of IEEE Engg., in Medicine and Biology Magazine, October, 1996.
5. Amon Cohen, Bio-Medical Signal Processing Vol I and II, CRC Press Inc., Boca Raton, Florida 1999.

6. Raghuveer M. Rao and Ajit S. Bopardikar, Wavelets transform – Introduction to Theory and its Applications, Addison – Wesley, India, 2000.
7. Michael C.K. Khoo, “Physiological Control System” – Analysis, Simulation and Estimation” – Prentice Hall of India, New Delhi, 2001.

MBI105	ANATOMY AND PHYSIOLOGY	3	0	0	3
BASICS					5
Basic Embryology, Osteology and Myology.					
CIRCULATORY AND RESPIRATORY SYSTEMS					10
Structure and Functioning of heart, structure and functioning of lungs, trachea and its branches, General circulation, capillary circulation, Venous return, neural control of cardio vascular system, regulation of breathing, carrier of oxygen and carbon dio-oxide, dyspnoea.					
NERVOUS AND SENSORY SYSTEM					10
Structure and function of nervous tissues, reflex action afferent nervous system, regulation of posture, physiology of emotion, regulation of temperature, cerebro spinal fluid, Sensory end organs, tongue, mechanism of sight, hearing and smelling.					
DIGESTIVE SYSTEM					8
Structure of alimentary canal, related digestive glands, and liver, mechanism of alimentary canal, secretion of digestive fluids, function of liver.					
EXCRETORY SYSTEMS					6
Structure of kidney, Bladder and colon, Physiology of Perspiration, Physiology of urine formation, Physiology of micturation, Physiology of defascation.					
ENDOCRINE SYSTEM					6
Pituitary gland, thyroid and parathyroid glands, pancreas, ovary and testis.					
REFERENCES:					
1. Best and Tayler, The living body, Bi publications, New Delhi, 1980.					
2. J.Gibson, Modern Physiology and Anatomy for nurses, Black Well scientific Publications, 1981.					
3. Cyril A. Keele and Eric Neil, Samsons Wright’s Applied Physiology, Oxford University Press, Hong Kong, 1983.					
MBI107	RADIOLOGICAL EQUIPMENTS	3	0	0	3
X – RAYS					10
Principle and production of soft X-Rays, Selection of anodes, heel pattern, Scattered radiation, porter-Bucky systems, Cooling System, Testing of various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, single plane and bi plane recording units, digital subtraction angiography, dental X-ray units.					
TOMOGRAPHY					8
Principle, plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of detection, image reconstruction, Spiral CT, Transverse Tomography.					
NUCLEAR MAGNETIC RESONANT					7
Principle, NMR Scanners, Imaging Different Sections of the Body, Tissue Characterization, NMR Spectroscopy.					
ISOTOPES					8
Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma camera, PET, SPECT.					
THERAPY USING X-RAYS AND ISOTOPES					7
Direct and Indirect effects of high energy radiation, Units for radiation Exposer, Depth Dose curves, Linear Accelerator Betatron., Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning.					
RADIATION SAFETY					5
Safety precautions Hazardous Effects of Radiations, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods, Radiological equipment specifications with respect to performances for RLE					
REFERENCES:					
1. Wagner H.N., Principles of Nuclear Medicine, W.B. Saunders Company, Philadelphia, 1969.					
2. Chesney D.N. and Chesney M.O., X-Ray Equipments for students Radiographer for students Radiographer, Blackwell scientific Publications, Oxford, 1971					
3. Jacobson B. and Webset J.G., Medicine and Clinical Engineering, Prentice Hall India. New Delhi 1979.					
4. Alexander, Kalender and Linke, Computer tomography, John Wiley, Chichester, 1986.					
5. Steve Webb, The physics of medical Imaging Adam Hilger, Philadelphia, 1988.					
6. Peggy W. Roger.D.Ferimarch, MRI for Technologists, Mcgraw Hill Publications, New York, 1995.					
MMG131A	ENGINEERING MANAGEMENT	3	0	0	3
OPERATION MANAGEMENT:					9
Operations management - Definition and concepts - Quality circles - Suggestion scheme for quality improvement - Total quality management concept - ISO Quality certifications and types - Quality assurance - Quality Audit - JIT, Six Sigma concept, Quality function deployment.					
MARKETING:					9
Basic concepts of marketing – Marketing mix – New product development (concepts & cases), Relationship marketing, Supply chain management, Product life cycle – Concepts of service marketing, Global marketing concepts.					
FINANCE:					9
Basic concepts of finance – Project finance – Long term finance – Short term finance – Working capital management – International finance – GDR – Financial forecasting – Leverage – Operating, financial & combined leverages.					

MANAGERIAL EFFECTIVENESS & LEADERSHIP:**9**

Measuring managerial effectiveness – Organizational climate – Leadership styles – Group influences – Team building – Organizational and managerial efforts – Self development – Negotiation skills – Development of the competitive spirit – Knowledge management – Forecasting creativity (case study).

ENTREPRENEURSHIP DEVELOPMENT:**9**

Entrepreneurship concept – Entrepreneurship as a career – Entrepreneur - Personality characteristics of successful entrepreneur – Knowledge and skills required for an entrepreneur – Business environment – Central and state Government Industrial policies and regulations – Business plan preparation: Matching entrepreneur with the project – Feasibility report preparation and evaluation (case study).

REFERENCES:

1. R. Panneerselvam, "Production and operation management", Prentice Hall of India, 2002.
2. Reddin W. J., "Effective management", Tata McGraw Hill company, New Delhi, 1998.
3. S. S. Khanka, "Entrepreneurship Development", S. Chand and Company Limited, New Delhi, 2001.
4. Gaither, "Production and Operations Management", Thompson Asia (P) Ltd., Bombay, Ninth edition, 2002.
5. Chase, Aquilano & Jacob, "Production and Operations Management", Tata McGraw Hill, 8th Edition, 1999.
6. Principles of Marketing: Philip Kotler, Tata McGraw Hill, 8th Edition, 2004.
7. Chakrabarthy, "Managerial effectiveness and Quality of Work life: Indian Insights, Tata McGraw Hill, 2000.
8. Hisrich, "Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.

SEMESTER II

MBI202 **BIO MEDICAL EQUIPMENTS & DEVICES** **3** **0** **0** **3**

CARDIAC CARE UNITS**6**

Pace makers – different types, batteries for pace makers, AC defibrillators, asynchronous and synchronous DC defibrillators, patient monitoring system.

NEUROLOGICAL EQUIPMENTS**10**

Stereo toxic unit, depth recording system, dot scanners, transcutaneous nerve stimulator, anesthesia Monitor, EEG controlled Anesthesia, Bio Feedback Equipments, Spinal Reflex Measurements, Front end devices for all Biomedical Equipments

DIATHERMY AND STIMULATOR**10**

Depth of penetration and physiological effects of H.F. radiation, short wave, Ultrasonics, and Micro Wave Diathermy, Surgical Diathermy, Physiological effects of stimulation, Galvanic, Farradical Surged types, Interfrantial Therapy.

BIO-TELEMETRY**8**

Principal, frequency selection for Telemetry, radio pills, multiplexing and tracking techniques, Telestimulation

RECENT TRENDS**6**

Principles of Thermography, detecting circuits, its application in medicine, principles of Cryogenic Techniques, its application in medicine, Principles of Fiber optic cable, Endoscopy, Laproscopy, Opthaimic Equipments.

ELECTRICAL SAFETY**5**

Micro and macro shock, sources of shock, monitoring and interrupting circuit from leakage current, Earthing scheme.

REFERENCES:

1. Albert M. Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982.
2. Feinberg B.N. Applied Clinical Engineering, Prentice Hall Inc., Engiewood Cliffs, New Jersey, 1986
3. Khandpur R.S. Handbook of Biomedical Instrumentation. Tata McGraw Hill Publishing company, New Delhi 1999.
4. Jacobson B. and Webster. J.G. Medicine and Clinical engineering, Prentice Hall of India, New Delhi, 1999
5. Leslie Cromwell, etal., Biomedical Instrumentation and measurements, Prentice Hall India, New Delhi, 2000

MBI204 **MEDICAL IMAGE PROCESSING** **3** **0** **0** **3**

IMAGE FUNDAMENTALS**8**

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

IMAGE PREPROCESSING**7**

Image enhancement – point operation, histogram modeling, spatial operations, transforms operations. Image restoration – image degradation model, inverse and Wiener filtering.

IMAGE ANALYSIS AND CLASSIFICATION**7**

Image analysis – spatial feature extraction, edge detection, image segmentation classification techniques – statistical methods, neural network approaches.

RECONSTRUCTION OF CT AND MRI IMAGES.**10**

Image reconstruction from projections – Radon transforms, filter back projection algorithm, algebraic methods, 3D tomography, imaging methods in CT images, imaging methods in magnetic resonance imagers, Fourier reconstruction of magnetic resonance images.

TRANSMISSION OF MEDICAL**5**

Medical image data compression and transmission – transform coding pixel coding, predictive coding, interframe coding.

SELECTED TOPICS IN MEDICAL IMAGE PROCESSING**8**

Application of image processing techniques in thermography, SPECT, PET, DSA, AI techniques in medical imaging. Biomagnetic diagnosis in connection with medical imaging of CT or MRI. Software implementation of image processing algorithms on medical images, Design consideration for RF cage

REFERENCES:

1. Albert Macouskl, Medical Imaging Systems, Prentice Hall New Jersey, 1983.
2. Gonzalez .R and Wintz .P, Digital Image Processing Addison Wesley Publishing Co. USA, 1987.
3. Eric Krestel Imaging Systems for Medical diagnosis, Siemens Aktiengesellschaft, FRG, 199.
4. Alfred Horowitz MRI Physics for Radiologists – A Visual Approach, Springer Verlag, New York, II Edition, 1991.
5. Anil K. Jain, Fundamental of Digital Image Processing, Prentice Hall of India Pvt Ltd., New Delhi, 1995.
6. M.A. Sid Ahmed, Image Processing, theory Algorithms and Architectures, Mcgraw Hill Book Company Siongapore, 1995.7.G.W.
7. Awock and R. Thomas “ Applied Image Processing”, Mcgraw Hill book company, Singapore 1996.

MBI206 LASER AND ULTRASONIC APPLICATION IN MEDICINE 3 0 0 3

LASER 10

Principles of Laser action, different types and of lasers and its operation, Applications of Laser in Biology, Dentistry, Ophthalmology, Dermatology, Medicine, Surgery, Interferometer Applications, Fluorescence studies in cancer Diagnosis, Laser in Genetic Engineering, Low power applications in Medicine.

ULTRASONICS 10

Different Modes of Display, a, B, C, scanning Techniques, Absorption in biological Tissues, Measurement of Ultrasonic Energy, Construction of Ultrasonic probe, Ultrasonic Imaging in Abdomen, Breast, Heart, Chest, Eye, Kidney, Skull, Pulsatile Motion, Pregnant and non-Pregnant uterus.

ULTRASONIC SCANNERS 8

Real Time Echo, 2-D Scanners, Colour Doppler.

HIGH ENERGY ULTRASONICS 8

Effects due to High energy ultrasonics applications in Surgery, Cell destruction, Cleaners.

HOLOGRAPHIC APPLICATION IN MEDICINE 9

Wave front Recording and Reconstruction, Recording Media, Image forming application, Motion Induced Contrast, correlation filtering, Holograms using Ultrasonic signals and Hologram using Lasers.

REFERENCES:

1. Leon Goldman, M.D., & R. Jamies Rockwell, Jr. Lasers in medicine Gordon and breach, science publishers Inc., New York, 1971.
2. Brown Y.H.V. and Dickson J.F. (Eds), Advances in Bio – Medical Engineering Volume II and V, Academic press, London, 1972.
3. Georg W. Stroke, Kock W.E., Ultrasonic Imaging and Holography, plenum press, New York, 1974.
4. Mertellucci S. S., and Chester A.N. Laser Photo biology and photo medicine, plenum press, New York, 1989.
5. Wolbarsht M.L., Laser Application in Medicine and Biology, Plenum press, New York, 1989.

MBI208 COMPUTER BASED MEDICAL INSTRUMENTATION 3 0 0 3

INTRODUCTION 10

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

MICROCONTROLLERS 10

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

SYSTEM DESIGN 8

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

COMPUTERS IN PATIENT MONITORING 8

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

MEDICAL EQUIPMENTS SYSTEM 9

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

REFERENCES:

Kenneth J. Ayala, The 8051 Micro Controller – Architecture Programming And Applications, Second Edition, Penram International, 1996.
Douglas V. Hall, Microprocessors and Interfacing: Programming and hardware, Mcgrase Hill, Singapore, 1999.

MBI210 BIO MEDICAL ENGINEERING LAB 0 0 4 2

LIST OF EXPERIMENTS

1. Patient monitoring system and Bio-telemetry
2. Plotting of Human auditory response using audiometer.
3. Performance and testing of Surgical Diathermy unit using Diathermy analyzer.
4. Recording of Electromyogram.
5. Construction and testing of Instrumentation amplifier.
6. Electrical Safety testing of equipment using international safety analyzer.
7. Construction and testing of nerve stimulator.
8. Study of HP page writer ECT machine
9. Study of picker EEG machine
10. Bio-Signal processing workstation.
11. Study of magnetic recorder for recording and retrieval of bio-signals
12. Analysis of bio-signals using FFT spectrum analyzer.

ELECTIVES

MBIE01 HUMAN ASSIST DEVICES

3 0 0 3

HEART LUNG MACHINES AND ARTIFICIAL HEART

10

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.

CARDIAC ASSIST DEVICES

8

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

ARTIFICIAL KIDNEY

8

Indication and Principles of hemodialysis, Membrane, Dialysate, Different Types of hemodialysers, Monitoring systems, Wearable Artificial Kidney, Implanting Type.

PROSTHETIC AND ORTHODIC DEVICES

10

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

RESPIRATORY AIDS

5

Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters.

HEARING AIDS

4

Audiograms, Types of Deafness Conductive and Nervous, Hearing Aids, Construction and Functional Characteristics.

REFERENCES

1. Leving S.N.(Ed.), Advances in Bio Medical Engineering and Medical physics. Volumes I, II and IV, Inter University Publications, New York, 1968.
2. Kolff W.J., Artificial Organs, John Wiley and Sons, New York 1979.
3. Andreas, F. Von racum, Hand book of bio material evaluation, Mc-Millan publishers, 1980.
4. Albert M. Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982.

MBIE02 ADVANCED NEURAL COMPUTING

3 0 0 3

FUNDAMENTAL CONCEPTS AND MODELS OF ARTIFICIAL NEURAL SYSTEMS

10

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

BPN AND BAM

10

Back Propagation Network, Generalised Delta Rule, BPN Application, Back – propagation Simulator, Associative Memory Definition, BAM, Hopfield Memory, simulating the BAM, Simulated Annealing – Boltzmann Machine, Boltzmann Simulator.

OTHER NETWORKS AND APPLICATIONS

8

Counter propagation Network, Feature Mapping, Self Organizing Feature Maps, Adaptive Resonance Theory (ART) Network Descriptions, Applications in Medical diagnosis.

OVERVIEW OF GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES

10

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

GENETICS ALGORITHM IN PROBLEM SOLVING AND MODELS

7

Data Analysis and Prediction Evolving of Neural Networks, Modeling, Interactions between learning and evolution. Applications in biomedical signal analysis and Medical diagnosis

REFERENCES:

Philip D. Wassermann, Advanced Methods in neural Computing, Van Nostrand Reinhold, New York 1993.
David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison – Wesley USA, 1997.
Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi, 1998.
Simon Haykins, Neural Networks, Prentice Hall International Inc, 1999.
James A Freeman and David M. Skapura, Neural, Networks, Addison – Wesley, India 1999.
Jacek M. Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House, India 1999.
Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engg., Prentice Hall of India, New Delhi, 2001.

MBIE03 HEALTH, HOSPITAL AND EQUIPMENT MANAGEMENT

3 0 0 3

HEALTH SYSTEM

10

Health organization of the country, the State the Cities and the Region, Health financing System, Organization of Technical Section.

HOSPITAL ORGANISATION AND MANAGEMENT

10

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

REGULATORY REQUIREMENT AND HEALTH CARE CODES

8

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

EQUIPMENT MAINTENANCE MANAGEMENT**10**

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

TRAINED TECHNICAL PERSONNEL**7**

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

REFERENCES:

1. Cesar a. Caceres and Albert Zara, The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Webster.J.G. and Albert M. Cook, Clinical Engineering Principles and Practices Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979.
3. Antony Kelly, Maintenance Planning and Control, Butterworths, London, 19804.
4. Hans Pfeiff, Vera Dammann (Ed.), Hospital Engineering in Developing Countries, Zreport, Eschborn, 1986.
5. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc., SanDeigo 1988.
6. R.C. Goyal, Handbook of Hospital Personnel Management, Prentice Hall of India, 1993.

MBIE04**MEDICAL INFORMATICS****3****0****0****3****BIOMEDICAL INFORMATION TECHNOLOGY****10**

Historical highlights of Healthcare Information systems – Biomedical Information systems – problems and pitfalls – History and evolution of Electric resources – Internet and Interactive Multimedia components.

OVERVIEW OF COMPUTER HARDWARE**7**

Motherboard and its logic – memory and I/O interfacing, memory and I/O map, I/O peripherals and add-on cards, RS 232-C and various IEEE standards.

HOSPITALS INFORMATION SYSTEMS**10**

Concept of HIS and its Position on the hospital – introduction of a computerized HIS-application of HIS in project management – Automation of Medical record – hospital Inventory data protection aspects – costs and benefits of HIS – transfer of information within the hospital – Modems and computer networking in Hospitals.

VISUAL PROGRAMMING AND MULTIMEDIA INFORMATION SYSTEMS**8**

Visuals Basic principles and programming – Design, Production and testing of multimedia based medical information systems.

INTEGRATED MEDICAL INFORMATION SYSTEMS**10**

Integration of Intra and Inter hospital information systems – Role of expert systems and fuzzy logic in medical information systems – Physiological system modeling and simulation – Concepts of Virtual reality, web based multimedia information systems – video conferencing.

REFERENCES:

1. S.K. Chauhan, "PC Organisation", S.K. Kataria and sons, Delhi.
2. Harold sackman, "Biomedical Informtion Technology, Academic Press, New York, 1997.
3. Mary Beth Fecko, "Electronic Resources: Access and Issues, Bowker-saur, London, 1997.
4. R.D. Lele, "Computers in medicine", Tata McGraw Hill, New Delhi, 1999.
5. Tay Vaughan, "Multimedia making it work", Tata McGraw Hill, New York, 1999.
6. Mark Spenik, "Visual Basic 6, Iterative Course", Techmedia, New Delhi, 1999.

MBIE05**REHABILITATION ENGINEERING****3****0****0****3****REHABILITATION TECHNOLOGY****12**

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

REHABILITATION SCIENCE**12**

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

REHABILITATION ADVOCACY**12**

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

REHABILITATION MEDICINE**9**

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

REFERENCES:

1. Reswick.J.What is Rehabilitation Engineering?, Annual Review of rehabilitation – volume 2 springer – verlag, New York, 1982.
2. Robinson.C.J, Rehabilitation Engineering Handbook of electrical engineering, CRC Press, Bocaaton, 1993.

MBIE06**RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING****3****0****0****3****STANDARDISATION OF HOSPITAL EQUIPMENTS****12**

Need for standardization, classification of equipments, international standards, Experimental methods of testing standards, maintenance of standards and recalibration.

CLINICAL ENGINEERING**8**

Hospital design, electrical, air – conditioning, sanitation, ventilation, safety regulation to be incorporated in the hospital center, management and legal aspects, latest drug delivery systems for sustained delivery of medicines.

NETWORKING**8**

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

FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS**12**

Different optical sources, optical detectors, principle of fiber optic cables, single mode multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.

EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS**5**

Principles of EMI, computation of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this unit from interference.

REFERENCES:

1. Donald R.J. White, A Handbook of electromagnetic Interference and Compatibility, Vol 4,5, Published by Donwhite Constant – Maryland, 1972.
2. Webster J.G. and Albert M. Cook, Clinical Engineering Principles and Practices Printice Hall Inc, Englewood Cliffs, New Jersey, 1979.
3. Bernhard Keiser, Principles of Eletromagnetic Compatibility, Artech House- 3rd Edition, 1986.
4. Eric Udd, Fiber Optic Sensors and introduction for engineers and scientists, Wiley Interscience Publication, New Delhi, 1991.
5. Bajbai, P.K. Ceramic – a novel device for sustained long term delivery of drugsBio Ceramic Vol III, Rose Heliman Institute of Technology, Terrahaute, Indian, 1992.
6. S.K. Basandia, Local Area Network, Golgotia Publishing Pvt Ltd., New Delhi, 1995.

MBIE07 SYSTEM THEORY APPLIED TO BIO-MEIDCAL ENGINEERING**3****0****0****3****INTRODUCTION****10**

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

TRANSFER FUNCTION**8**

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

IMPEDANCE CONCEPT**8**

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

PERIODIC SIGNALS**10**

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.

FEEDBACK**4**

Characterization of Physiological Feedback, System, Uses and Testing of System Stability.

SIMULATION OF BIOLOGICAL SYSTEMS**5**

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

REFERENCES:

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

MBIE08 BIOLOGICAL EFFECTS OF RADIATION**3****0****0****3****ACTION OF RADIATION ON LIVING CELLS****10**

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

SOMATIC APPLICATION OF RADIATION**8**

Radiosensitivity protocols of different tissues of human, LA\ND 50/30 effective radiation on skin, bone marrow, eye, endocrine glands, basis of radiotherapy.

GENETIC EFFECTS OF RADIATION**8**

Thresholds and linear dose, gene control hereditary diseases, effect of dose and I Inflneceson genetic equilibrium.

EFFECT OF MICROWAVE AND RF WITH MATTERS**12**

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

UV RADIATION**7**

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

REFERENCES:

1. Glasser.O. Medical Physics, vol I, II, III, The year book Publishers Inc., Chicago, 1980.
2. Baranski.S and Cherski.P, Biological effects of microwave, Hutchison and Ross Inc., Stroudsburg, 1980.
3. Moselly.H non-ionizing Radiation, Adam-Hilgar, Bristol, 1988.

MBIE09	PATTERN RECOGNITION AND APPLICATION	3	0	0	3
OVERVIEW OF PATTERN RECOGNITION		10			
Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood estimation – Bayesian parameter estimation – Perceptron Algorithm – Problems with Bayes Approach – Pattern Classification by distance functions – minimum distance pattern classifier.					
UNSUPERVISED CLASSIFICATION		8			
Clustering for unsupervised learning and classification, clustering concepts C-means algorithm – hierarchical clustering – Graph theoretic approach to pattern clustering – Validity of clustering solutions.					
FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION		8			
KL Transforms – feature selection through functional approximation – Binary selection-Elements of formal grammars, syntactic description, Stochastic grammars, Structural representation.					
AI TECHNIQUES		9			
Search and control strategies – Uniformed search – Informed search – searching AND graphs – Matching techniques – Knowledge for recognition and classification process – visual image understanding – Expert system architectures.					
RECENT ADVANCES AND IMAGE APPLICATIONS		10			
Learning of neural pattern recognition – Fuzzy logic – Fuzzy logic – Fuzzy pattern classifiers – image segmentation – Credit scoring – Techniques for colon Endoscopy – Target classification of cancer cells – Cancer cells – Cell cytology classification – Mixture modeling of excited and living ovine hearts – bacterial classification.					
REFERENCES:					
1. Dudo R.O., and Hart P.g., Pattern Classification and scene analysis, John Wiley New York, 1973.					
2. Elaine Rich, Artificial Intelligence, McGraw Book company, Singapore, 198.					
3. Robert Jchalkoff, Pattern recognition: Statistical Structural and Neural approaches, John Wiley and Sons Inc., New York, 1992.					
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.					
5. Dan Patterson, Introduction to artificial Intelligence and Expert Systems, Prentice Hall of India, 1997.					
6. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London, 1999.					
7. Donna L Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi – 2001.					
MBIE10	SPECIAL TRANSDUCERS AND INSTRUMENTATION	3	0	0	3
BASIC CONCEPTS OF MEASUREMENT		7			
Transducer Categories, Characteristics of Transducers Static and Dynamic Characteristics of Measurement.					
FORCE, PRESSURE AND MOTION MEASUREMENT		8			
Various Transducers Capable of Measuring Low Pressure and Force, Its measuring System, External and Catheter tip Transducers, Transducer to Measure Single Movement and Differential Movements, Velocity Transducer, Seismic Pick Up, Accelerometer.					
FLOW MEASUREMENT		7			
Transducer to Measure Velocity, Magnitude and Direction Flow various Methods of measuring these Parameter. In vivo and In vitro Type of Measurements.					
CHEMICAL AND OPTICAL TRANSDUCER		10			
Ion Sensor, Anion and Cation Sensor, Liquid and solid Ion Exchange Membrane Electrodes, Enzyme Electrodes, Molecular Electrode, Fiber Optic Sensor, Photo Acoustic Sensors, PPG Sensors.					
TEMPERATURE AND RADIATION MEASUREMENT		8			
Various Thermal Sensors Including Integrated Circuit Thermal Sensors, Radiation Thermometry and Chemical Thermometry, Scintillation technique, Gas ionization type films.					
DATA ACQUISITION RECORDING		5			
Signal Conditioners, Single and Multi Channel data acquisition System, DATA Transmission system, Various Types of recorders, Multichannel column display oscilloscope, Multi colour dot scanner, Magnetic recorder.					
REFERENCES:					
1. Michael R. Newman, David G. Flemming, Physical Sensors for Bio Medical Applications, CRC Press Inc, Florida, 1980.					
2. Rangan C.S., Sarma G.R., And Mani V.S.V., Instrumentation Devices and System, Tata McGraw Hill Publication Company Limited, New Delhi, 1983.					
3. Jacob Kline., Handbook of Bio Medical Engineering, Academic Press Inc., San Diego 1988.					
4. George C. Barney, Intelligent Instrumentation, Prentice Hall of India, New Delhi, 1988.					
5. Earnest O. Doebelin., Measurement System Application and Design., McGraw Hill, New York, 1990.					