AFFILIATED INSTITUTIONS

ANNA UNIVERSITY , CHENNAI

REGULATIONS - 2009

CURRICULUM II TO IV SEMESTERS (FULL TIME)

M.E. MEDICAL ELECTRONICS

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MX9321	Medical Image Processing	3	0	0	3
2	MX9322	Medical Imaging And Radio Therapy	3	0	0	3
3	E2	Elective II	3	0	0	3
4	E3	Elective III	3	0	0	3
5	E4	Elective IV	3	0	0	3
6	E5	Elective V	3	0	0	3
PRACTICAL						
7	MX9323	Data Acquisition and Processing Lab	0	0	4	2
		TOTAL	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	E6	Elective VI	3	0	0	3
2	E7	Elective VII	3	0	0	3
3	E8	Elective VIII	3	0	0	3
PRACTICAL						
4	MX9331	Project Work (Phase I) Summer Training Prerequisite	0	0	12	6
		TOTAL	**6**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MX9341	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 68

ELECTIVES LIST

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1	MX9001	Medical informatics	3	0	0	3
2	MX9002	Advances in Electronics applied to Hospital Engineering	3	0	0	3
3	MX9003	Human assist devices	3	0	0	3
4	MX9004	Computer based medical Instrumentation.	3	0	0	3
5	MX9005	Advanced Neural computing.	3	0	0	3
6	MX9006	Health Hospital and Equipment management.	3	0	0	3
7	MX9008	Physiological modeling	3	0	0	3
8	MX9009	Pattern recognition Techniques and Applications	3	0	0	3
9	MX9010	Tissue Engineering.	3	0	0	3
10	MX9011	Bio MEMS	3	0	0	3
11	MX9012	Principles of Genetic Analysis	3	0	0	3
12	MX9013	Wavelet transforms and its application	3	0	0	3
13	MX9014	Tele Health technology .	3	0	0	3
14	VL9211	DSP Integrated Circuits	3	0	0	3
15	MX9016	Bio Mechanics	3	0	0	3
16	MX9017	Brain Control Interfaces	3	0	0	3

MX9321   **MEDICAL IMAGE PROCESSING**   **L T P C**
                                                     3 0 0 3

UNIT I   IMAGE FUNDAMENTALS   9

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

UNIT II   IMAGE PREPROCESSING   9

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

UNIT III   MEDICAL IMAGE RECONSTRUCTION   9

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

UNIT IV   IMAGE ANALYSIS AND CLASSIFICATION   9

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

UNIT V   IMAGE REGISTRATIONS AND VISUALIZATION   9

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

L = 45 : TOTAL: 45 PERIODS

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

MX9322   **MEDICAL IMAGING AND RADIO THERAPY**   **L T P C**
                                                                        3 0 0 3

UNIT I   X – RAYS   9
Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, dental X- ray units.

UNIT II   TOMOGRAPHY   9
Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography.

UNIT III   EMISSION IMAGING   9
Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT.

UNIT IV   MAGNETIC RESONANCE IMAGING   9
Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterisation, MR Spectroscopy, Functional MRI.

UNIT V   THERAPY USING X – RAYS AND ISOTOPES   9
Direct and Indirect effects of high energy radiation, Units for radiation Exposer, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

L = 45 : TOTAL: 45 PERIODS

REFERENCES:
1. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
2. Jacobson B. and Webster J.G., Medicine and Clinical Engineering, Prentice Hall India, New Delhi, 1999.
3. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chich~ster, 1986.
4. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.
5. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, Mc Graw Hill Publications, New York,1995
6. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics , Churchill Livingston, 5th Edition.
7. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince
   MRI from picture to proton ,Cambridge University press, New York 2006.

MX9323   DATA ACQUISITION AND PROCESSING   L T P C
                 LABORATORY   0 0 4 2

LIST OF EXPERIMENTS

1. Electrical Safety testing of equipment using international safety analyzer
2. Acquisition and analysis of bio- signals using workstation.
3. Study of magnetic recorder for recording and retrieval of bio-signals.
4. Analysis of bio-signals using FFT spectrum analyzer
5. Development of Neural Network for signal classification.
6. Development of Software for basic TELEMEDICINE
7. Study of lung and cardiovascular models
8. Analysis of medical images
9. Development of software for Medical Image compression.
10. Miniproject (Should include hardware and software)

MX9001   MEDICAL INFORMATICS   L T P C
                                                          3 0 0 3

UNIT I   HEALTH INFORMATICS   9
Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, e – health services, Medical Standards – HL7 – DICOM – PACS, Medical data formats – Bioethics.

UNIT II   MEDICAL INFORMATICS   9
Medical Informatics and its six levels of interfaces, Electronic Patient Record (EPR), Medical data storage and retrieval techniques – Steganography, Evidence based Medicine- Virtual Hospital

UNIT III   SOFT COMPUTING   9
Fuzzy logic – its applications in Medicine, Physiological System Modeling and Simulation, Virtual Reality and Multimedia Applications in Medicine, Surgical Simulation, Clinical Expert Systems, Issues related to Web based Health Care Systems design, development and implementation.

UNIT IV   JAVA PROGRAMMING   9
Genesis of JAVA, Data types, Operators, Control statements, Classes – Inheritance – packages and interfaces – I/O applets, String handling Applet Classes – AWT and Swing classes - Java applets, Java servelets, Java script programming, Creating events, interactive forms, frames, documents, spread sheets and windows- Client – Server programming

UNIT V   INTERNET AND WEB   9
Web Design and programming, HTTP protocol, Web browsers Netscape, Internet explorer, Web site and web   page design, HTML,XHTML, XML, CSS, Dynamic HTML, CGI. Data base design and programming, SQL introduction – Queries – Tables – RDBMS, Macromedia Dream Weaver, Web Servers, Databases – SQL, MYSQL, DBI and ADO.NET, Web based Medical Information Systems.

L = 45 TOTAL : 45 PERIODS

REFERENCES

1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
3. Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
5. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
6. Tay Vaughan, Multimedia – Making it Work, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Raif Steinmetz, Multimedia – Computing, Communications and Applications, Pearson Education, New Delhi, 2007
8. Deitel, "Java How to Program", Pearson Education / PHI, 2006.
9. A S Godbole A Kahate, "Web Technologies, TCP/IP to Internet Application Architectures", TMH 2007

MX9002	ADVANCES IN ELECTRONICS APPLIED	L T P C
	TO HOSPITAL ENGINEERING	3 0 0 3

UNIT I   CLINICAL ENGINEERING   9

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

UNIT II   NETWORKING   9

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

UNIT III   FIBRE OPTIC SENSORS FOR MEASURING

**   PHYSIOLOGICAL PARAMETERS   9**

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

UNIT IV   EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS   9

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

UNIT V   VIRTUAL REALITY APPLICATION   9

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

L = 45 TOTAL = 45 PERIODS

REFERENCES

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

MX9003   **HUMAN ASSIST DEVICES**   **L T P C**
                                                                          3 0 0 3

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 ORTHODIC DEVICES   9

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

UNIT V   RESPIRATORY AND HEARING AIDS.   9

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

L = 45 TOTAL = 45 PERIODS

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

MX9004 COMPUTER BASED MEDICAL INSTRUMENTATION   **L T P C**
                                                     3 0 0 3

UNIT I   PC HARDWARE AND OVERVIEW   9
Hardware – BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board – I / O slots – Mother Board logics- Memory and I/O map, Peripheral interfacing and controllers- Serial and Parallel interface – CRT Display Adapter – FDC – HDC – PC buses

UNIT II   80186, 80286, 80386 AND 80486 MICROPROCESSORS   9
80186 Architecture, Enhancements of 80186 – 80286 Architecture – Real and Virtual Addressing Modes – 80386 Architecture – Special Registers – Memory Management – Memory Paging Mechanism – 80486 Architecture – Enhancements – Cache Memory Techniques – Exception Handling – Comparison of Microprocessors (8086 – 80186 – 80286 – 80386 – 80486).

UNIT III   PENTIUM MICROPROCESSORS   9
Pentium Microprocessor Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II Microprocessor Architecture – Pentium III Microprocessor Architecture – Pentium III Architecture – Pentium IV Architecture – Comparison of Pentium Processors.

UNIT IV   COMPUTERISED DATA ACQUISITION AND PROGRAMMING   9
Plug-in-data acquisition and Control Boards, Data acquisition using GPIB and Serial Interfaces and Programming in C, Virtual reality – Multimedia - Telemedicine – Computers in Critically Care Units and radiological centres

UNIT V   BIOMETRICS FOR NETWORK SECURITY   9
Introduction to Biometrics and its characteristics, Finger print technology, feature extraction and classification, Face recognition and hand geometry - feature extraction and classification, Biometric authentication system

                                       L = 45 TOTAL = 45 PERIODS

REFERENCES
1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.

3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

MX9005 **ADVANCED NEURAL COMPUTING** **L T P C**
3 0 0 3

**UNIT I FUNDAMENTAL CONCEPTS AND MODELS
OF ARTIFICIAL NEURAL SYSTEMS 9**
Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II BPN AND BAM 9
Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory Definition, BAM, Hopfield Memory, Simulated Annealing-Boltzmann Machine.

UNIT III OTHER NETWORKS 9
Counter Propagation Network, Feature Mapping, Self Organising Feature Maps, Adaptive Resonance Theory (ART) Network Descriptions,

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 10
The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling

UNIT V ADVANCES AND APPLICATIONS 8
Support Vector Machines, R B F Network, Neocognitron
Evolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

TOTAL = 45 PERIODS

REFERENCES
1. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold,NewYork 1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison - Wesley USA,1997.

3. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998.   .
4. Simon Haykins, Neural Networks ,Prentice HallinternationalInc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison – Wesley,India 1999.

MX9006   HEALTH HOSPITAL AND EQUIPMENT MANAGEMENT   L   T   P   C
3   0   0   3

UNIT I   HEALTH SYSTEM   9
Health organisation of the country, the State, the Cities and the Region, Health Financing System, Organisation of Technical Section

UNIT II   HOSPITAL ORGANISATION AND MANAGEMENT   9
Management of Hospital Organisation, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Team Work, Legal aspect in Hospital Management.

UNIT III   REGULATORY REQUIREMENT AND HEALTH CARE CODES   9
FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.

UNIT IV   EQUIPMENT MAINTENANCE MANAGEMENT   9
Organising Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance.

UNIT V   TRAINED TECHNICAL PERSONNEL   9
Function of Clinical Engineer, Role to be performed in Hospital, Manpower Market, Professional Registration, Structure in Hospital.
L = 45 TOTAL = 45 PERIODS

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

MX9008   **PHYSIOLOGICAL MODELING**   **L T P C**
                                                                  3 0 0 3

UNIT I   INTRODUCTION   9
System Concept, System Properties, Piece-Wise Linear Approximation, Electrical Analog for Compliance, Thermal Storage, Mechanical Systems, Step response of a Resistance/Compliant Systems, Pulse Response of First Order System.

UNIT II   TRANSFER FUNCTION   9
System as an Operator use of Transfer Function, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT III   PERIODIC SIGNALS   9
Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Function s from Frequency Response, Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system, General Description of Natural Frequency Damping, Physical Significance of Under Damped Responses.

UNIT IV   FEEDBACK   9
Characterization of Physiological Feedback. Systems, Uses and Testing of System Stability.

UNIT V   SIMULATION OF BIOLOGICAL SYSTEMS   9
Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

                                                L =45 TOTAL = 45 PERIODS

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

MX9009   **PATTERN RECOGNITION TECHNIQUES**   **L T P C**
                                   AND APPLICATIONS   **3 0 0 3**

UNIT I   OVERVIEW OF PATTERN RECOGNITION   9
Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation - Perceptron Algorithm-LMSE

Algorithm-Problems with Bayes Approach-Pattern classification by distance functions -minimum distance Pattern classifier.

UNIT II   UNSUPERVISED CLASSIFICATION   9
Clustering for unsupervised learning and classification ,clustering concepts C- means algorithm - hierarchical clustering - Graph theoretic approach to pattern clustering-Validity of clustering solutions.

UNIT III   FEATURE EXTRACTION AND STRUCTURAL
**   PATTERN RECOGNITION   9**
KL Transforms - feature selection through functional approximation - Binary selection Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV   FUZZY SYSTEMS   9
Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – fuzzy automata and languages- fuzzy control method- fuzzy decision making.

UNIT V   RECENT ADVANCES AND APPLICATIONS   9
 Principle of neuro fuzzy techniques, Application of PR in image segmentation - Credit scoring - Techniques for colon endoscopy - Target classification of Cancer cells - Cell cytology classification
                                        L = 45 TOTAL = 45 PERIODS

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

MX9010   TISSUE ENGINEERING   L T P C
**   3 0 0 3**

UNIT I   FUNDAMENTAL OF TISSUE ENGINEERING   9
Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development.

UNIT II   CELLULAR STUDIES   9
Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

**UNIT III   TISSUE BARRIERS TO MOLECULAR
                AND CELLULAR TRANSPORT   9**
Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space.

UNIT IV   INTRODUCTION TO POLYMERS   9
Non degrade polymer, Bio degradable polymer, cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.

UNIT V   APPLICATION OF TISSUE ENGINEERING   9
Artificial organs, synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin, and nerve regeneration.

                                        L =45 TOTAL = 45 PERIODS

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

**MX9011   BIO MEMS   L T P C
                                                            3 0 0 3**

UNIT I   MEMS AND MICROSYSTEMS   9
Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

UNIT II   MICROSENSORS AND ACUATORS   9
Mechanical sensors and actuators – beam and cantilever, piezoelectric materials, thermal sensors and actuators- micromachined thermocouple probe, Peltier effect heat pumps, thermal flow sensors, Magnetic sensors and actuators- Magnetic Materials for MEMS, Devices

UNIT III   MICRO OPTO ELECTRO MECHANICAL SYSTEMS   9
Fundamental principle of MOEMS technology, light modulators, beam splitter, microlens, digital micromirror devices, light detectors, optical switch

UNIT IV   MICROFLUIDIC SYSTEMS   9
Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system

UNIT V   BIOMEMS   9
Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip
                                        L = 45 TOTAL = 45 PERIODS

REFERENCES
1.   Tai Ran Hsu , " MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002

2. Nitaigour Premchand Mahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Wanjun Wang, Steven A.Soper " BioMEMS- Technologies and applications", CRC Press,Boca Raton,2007
4. Abraham P. Lee and James L. Lee, BioMEMS and Biomedical Nano Technology, Volume I, Springer 2006.

MX9012   **PRINCIPLES OF GENETIC ANALYSIS**   **L T P C**
                                                                    3 0 0 3

UNIT I   **INHERITANCE - GENETIC ANALYSIS**   **9**
Pattern of inheritance, Chromosomal basis of inheritance, Chromosome mapping by recombination, Genetics of Bacteria and viruses.

UNIT II   **DNA AND PHENOTYPE**   **9**
From Gene to Phenotype, DNA structure and replication- DNA sequencing, DNA Amplification, DNA Hybridisation and DNA Polymorphism, RNA transcription and processing, Protein synthesis and regulation of gene expression.

UNIT III   **GENOME STRUCTURE AND GENETIC ENGINEERING**   **9**
Gene isolation and manipulation, Genomics, mutations, repair and recombination, site directed mutagenesis, large-scale chromosomal changes and genetic polymorphism.

UNIT IV   **GENETIC PROCESSES**   **9**
Gene function, Genetic organization, Genetic regulation, normal and cancer cells, Genetic basis of development

UNIT V   **IMPACT OF GENETIC VARIATION**   **9**
Population Genetics, Quantitative Genetics, Evolution Genetics.

                                         L =45 TOTAL = 45 PERIODS

REFERENCES

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

MX9013   WAVELET TRANSFORMS AND ITS APPLICATIONS   L T P C
3 0 0 3

UNIT I   FUNDAMENTALS OF SIGNAL DECOMPOSITIONS   9
Series expansion of signals, Multi resolution concepts – Hilbert spaces – Vectors space and inner products, complete inner product spaces, orthogonal and general basis. Fourier theory and sampling – Fourier transform, Fourier series, direct function, Impulse trains and Poisson sum formula, DFT, DTFT, DTFS. Signal Processing – Continuous, Discrete and Multi rate discrete time signal processing. Time frequency representation.

UNIT II   DISCRETE TIME BASIS AND FILTER BANKS   9
Series expansion of DTS – DTFS, Haar expansion of DTS, Sinc expansion of DTS. Tree – Structured filter banks – Octave-band filter bank, Discrete time Wavelet series and properties, Multi resolution, Interpretation, Wavelet packets. Multi channel filter banks – Block and lapped orthogonal transforms, Analysis of multi channel and modulated filter banks. Multi dimensional filter banks – Analysis and Synthesis.

UNIT III   MULTI RESOLUTION CONCEPT AND MODULATED BASES   9
Multi resolution analysis – Wavelet function, DWT. bases, orthogonal basis and biorthogonal bases. Scaling function, scaling coefficients, Wavelet and wavelet coefficients – Scaling function and wavelet. Properties of scaling function and wavelet. Parameterization of scaling coefficients. Calculating the basic scaling function and wavelet. Local cosine bases – Rectangular window, smooth window and general window.

UNIT IV   WAVELET SYSTEM DESIGN   9
Daubechie's method for zero wavelet moment design. Non-maximal regularity wavelet design. Relation of zero wavelet moments to smoothness, Approximation of scaling coefficients by sample of the signal and by scaling function projection. Tiling the time frequency and time scale plane.

UNIT V   APPLICATIONS   9
Wavelet, wavelet packets and matching pursuits with bio medical applications – analysis of phono cardiogram signals, feature extraction for neuro physiological signals, speech enhancements for hearing aids. Wavelets in medical imaging – wavelets applied to mammograms, adapted wavelet encoding in fMRI, wavelet compression of medical images. Video compression, denoising, edge detection, and discrete wavelength multi tone modulation.

L =45 TOTAL = 45 PERIODS

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

MX9014   **TELEHEALTH TECHNOLOGY**   **L T P C**
                                                                 3 0 0 3

UNIT I   TELEMEDICINE AND HEALTH   9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II   TELEMEDICAL TECHNOLOGY   9

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

UNIT III   TELEMEDICAL STANDARDS   9

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

UNIT IV   MOBILE TELEMEDICINE   9

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

UNIT V   TELEMEDICAL APPLICATIONS   9

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

                                                         TOTAL = 45 PERIODS

REFERENCES
1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006

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

VL9211   **DSP INTEGRATED CIRCUITS**   **L T P C**
                                                                   3 0 0 3

UNIT I   DSP INTEGARTED CIRCUITS AND
**   VLSI CIRCUIT TECHNOLOGIES   9**
Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.

UNIT II   DIGITAL SIGNAL PROCESSING   9
Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal-processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.

UNIT III   DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS   9
FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT IV   DSP ARCHITECTURES AND SYNTHESIS
**   OF DSP ARCHITECTURES   9**
 DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures.   Mapping   of   DSP   algorithms   onto   hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

UNIT V   ARITHMETIC UNITS AND INTEGRATED CIRCUIT DESIGN   9
Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolator as case studies. Cordic algorithm.

L = 45 TOTAL = 45 PERIODS

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

MX9016	BIO-MECHANICS	L T P C
		3 0 0 3

UNIT I   INTRODUCTION   9
Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, mechanical properties of soft biological tissues.

UNIT II   MECHANICS OF CIRCULATION   9
Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III   MECHANICS APPLIED TO ORTHOPAEDICS   9
Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, analysis of force in orthopedic implants.

UNIT IV   MECHANISM OF BIOLOGICAL SYSTEMS   9
Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V   BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION   9
Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

L = 45 TOTAL = 45 PERIODS

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

MX9017   **BRAIN CONTROL INTERFACES**   **L T P C**
                                                                   3 0 0 3

UNIT I   INTRODUCTION TO BCI   8
Concept of BCI – Invasive and Non-invasive Types – EEG Standards – Signal Features – Spectral Components – EEG Data Acquisition – Pre-processing – Hardware and Software – Artifacts – Methods to Remove – Near Infrared BCI.

UNIT II   BCI APPROACHES   7
Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

UNIT III   EEG FEATURE EXTRACTION METHODS   10
Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering – PCA – Laplacian Filters – Linear and Non-linear Features.

UNIT IV   EEG FEATURE TRANSLATION METHODS   10
LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

UNIT V   CASE STUDY   10
Case Study of Problems in BCI Competition III(2005) – Dataset I, II, III, IV and V – Solutions. Case Study of Brain Actuated Control of Khepera Mobile Robot.

L = 45 TOTAL = 45 PERIODS

REFERENCES:
1.   Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
2.   Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.
3.   R.Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, oca Rato, Florida.
4.   Bishop C.M, "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
5.   Torsten Felzer, "On the possibility of Developing a Brain Computer Interface", Technical Report, Technical University of Darmstadt, Germany, 2001.
6.   Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.
7.   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.
9.   S.Coyle, T.Ward et al, "On the suitability of near infra red systems for next generation Brain Computer interfaces", Physiological Measurement, 25, 2004.
10. Carlo Tomasi, "Estimating Gaussian Mixture Densities with EM – A Tutorial", Duke University, 2000.
11. R.Dugad, U.B Desai, " A Tutorial on Hidden Markov Modeling", Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
12. http://ida.first.fhg.de/projects/bci/competition_iii