Program structure

For

M.TECH- BIOMEDICAL SIGNAL PROCESSING & INSTRUMENTATION

SCHEME OF TEACHING AND EXAMINATION

M.TECH- BIOMEDICAL SIGNAL PROCESSING & INSTRUMENTATION

I SEMESTER

Sl No	Subject Code	Cource Title	CREDITS				Contact Hours	Marks			Exam Duration in hrs
			L	T	P	TOTAL		CIE	SEE	Total	
1	BSI 110	Linear Algebra and Applications	4	1	0	5	6	50	50	100	03
2	BSI 120	Physiology for Engineers	4	0	1	5	6	50	50	100	03
3	BSI 130	Clinical Instrumentation	4	0	1	5	6	50	50	100	03
4	BSI14X	Elective I				5	6	50	50	100	03
5	BSI15X	Elective-II				5	6	50	50	100	03
6	BSI 160	Seminar	0	0	2	3	-	50	-	50	
			Total Credits			27		Total Marks		550	

Subject Code	**ELECTIVE – I**	L	T	P	TOTAL
BSI 141	Real Time Signal Processing	4	0	1	5
BSI142	Bio-materials & artificial organs	4	1	0	5
BSI143	Biosensors	4	0	1	5
BSI144	Neural Networks and fuzzy Logical Medicine	4	0	1	5

Subject Code	**ELECTIVE – II**	L	T	P	TOTAL
BSI 151	Micro and Smart System Technology - 1	4	0	1	5
BSI152	Ergonomics	4	0	1	5
BSI153	Biomechanics	4	1	0	5
BSI154	Bio Informatics and Applications	4	0	1	5

SCHEME OF TEACHING AND EXAMINATION

M.TECH.- BIOMEDICAL SIGNAL PROCESSING & INSTRUMENTATION

II SEMESTER

Sl No	Subject Code	Cource Title	CREDITS				Contact Hours	Marks			Exam Duration in hrs
			L	T	P	TOTAL		CIE	SEE	Total	
	BSI 210	Advanced Biomedical Signal Processing	4	1	0	5	6	50	50	100	03
	BSI 220	Digital Image Processing	4	0	1	5	6	50	50	100	03
	BSI 230	Medical Imaging	4	0	1	5	6	50	50	100	03
	BSI 24X	Elective – III				5	6	50	50	100	03
	BSI 25X	Elective – IV				5	6	50	50	100	03
	BSI 260	Seminar	0	0	2	3	-	50	-	50	
			Total Credits			27		Total Marks		550	

Subject Code	**ELECTIVE – III**	L	T	P	TOTAL
BSI 241	Speech Signal Processing	4	0	1	5
BSI 242	Wavelets in Biomedical Engineering	4	1	0	5
BSI 243	Computers inTomography	4	0	1	5
BSI 244	Pattern Reorganization	4	0	1	5

Subject Code	**ELECTIVE – IV**	L	T	P	TOTAL
BSI 251	Micro and smart system – 2	4	0	1	5
BSI 252	Virtual bio- Instrumentation	4	1	0	5
BSI 253	ARM Embedded system design	4	0	1	5
BSI 254	Theory & design of bio- medical instruments	4	0	1	5

APPENDIX

SCHEME AND SYLLABUS FOR M.TECH IN *BIOMEDICAL SIGNAL PROCESSING & INSTRUMENTATION P.G COURSE STRUCTURE.*

It is proposed to have following subjects for all the P.G Courses.

Total credits 100

Semester 1:	3 Core Subjects (5 Credits X 3)	= 15 (4:0:1 or (4:1:0)
	2 Electives (5 Credits X 2)	= 10 (4:0:1 or (4:1:0)
	1 General Seminar	= 02
TOTAL		**27 credits**
Semester 2:	3 Core Subjects (5 Credits X 3)	= 15 (4:0:1 or (4:1:0)
	2 Electives (5 Credits X 2)	= 10 (4:0:1 or (4:1:0)
	1 General Seminar	= 02
TOTAL		**27 credits**

Industrial Training 8 weeks	= 4 Credits
Project work and dissertation	= 42 Credits
TOTAL	**100 credits**

Academic schedule :

Course work

(16 weeks + 1 week preparation + 2 weeks exams + 2 week vacation)

General Guidelines:

1. Credit pattern of L.T. P means lecturer, tutorials and practicals
2. 2 hours of tutorials / practicals is equal to 1 credit 1 hour of lecture is 1 credit
3. Tutorials can be used for problem solving, assignments, interaction, Simulation etc
4. CIE: Continuous internal assessments, 5 events to be conducted of which 2 have to be TESTS remaining events can be used for lab work, mini project etc, **There shall be no choice in the question paper set for the test**
5. The events have to be spread uniformly throughout the semester and are to be conducted according to the schedule fixed by department
6. Proper documentation is to be maintained for all the computation of CIE
7. The question paper for SEE (Semester end Evaluation) will be set by the faculty teaching the courses. There will be no choice as for as the units are concerned for student. Each of the 5 units will carry a weitghtage of 20 marks. However, within certain units, internal choice can be given. So, question for 150 marks can be asked out of whish student will attempt for 100 marks.
8. Based on the total marks obtained (CIE + SEE) grades are awarded on relative grading scheme
9. A student who does not have a minimum 25 out of 50 in CIE cannot appear for SEE
10. A student should get a minimum of 40 percent in SEE for a pass
11. A student failing in SEE has to repeat the course
12. The syllabus can be split in to 5 units. For 3:x:y courses 40 hours of coverage is recommended. For 4:x:y courses 50 hours of coverage is recommended

LINEAR ALGEBRA & APPLICATIONS

Subject Code	**:**	**BSI 110**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Linear Equations: System of linear equations, Row reduction and echelon forms, Vector equations, Matrix equations, Solution sets of linear systems; Applications of Linear systems, matrix operations; inverse of a matrix, Matrix factorization, Applications to computer graphics.

Vector Spaces: Vector spaces and subspaces; Linearly independent sets; bases, coordinate systems, dimension of a vector space; Rank, Change of basis Applications to difference equations.

Linear Transformations: Linear transformations; eigen vectors and eigen values, characteristic equation, diagonalization, eigen vectors and linear transformation, Complex eigen values, Applications to differential equations.

Orthogonality and Least Squares: Inner products, length and orthogonality, orthogonal sets, orthogonal projections; Gram-Schmidt process; QR-factorization; least-squares problems; Inner products spaces, Application to linear models, Application of inner product spaces.

Symmetric Matrices and Quadratic Forms: Digitalization of symmetric matrices; quadratic forms; constrained optimization; singular value decomposition, Application to image processing and statistics

TEXT BOOK:

1. David C. Lay, "**Linear Algebra and its Applications**", 3rd Edition, Pearson Education (Asia) Pvt. Ltd, 2005.

REFERENCES:

1. Gilbert Strang, "**Linear Algebra and its Applications**", 4thEdition, Thomson Learning Asia, 2007.
2. Bernard Kolman and David R. Hill, "**Introductory Linear Algebra with Applications**," Pearson Education (Asia) Pvt. Ltd, 7th edition, 2003.

PHYSIOLOGY FOR ENGINEERS

Subject Code	**:**	**BSI 120**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

General Physiology: Cell, Cell junctions, Transport through cell membrane, Homeostasis, Acid base balance.

Respiratory System & Environmental Physiology: Physiological anatomy of respiratory tract, Pulmonary circulation, Mechanics of respiration, Pulmonary function tests, Ventilation, Exchange of respiratory gases, Transport of respiratory gases, Regulation of respiration, Artificial respiration.

Renal Physiology : Kidney, Nephron, Juxtaglomerular apparatus, Renal circulation, Urine formation, Concentration of urine, Acidification of urine, Renal function tests, Renal disorders, Micturition, Uro flow studies, Dialysis.

Cardiovascular System : Introduction to cardiovascular system, Properties of cardiac muscle, Cardiac cycle, Heart sounds, Cardiac murmurs, Electrocardiogram, Vector, Arrhythmia, Cardiac output, Regulation of heart rate, Hemodynamics, Arterial blood pressure, Hemorrhage.

GIS : GIS, Functions of stomach, pancreas, liver, intestine, function tests: endoscopies.

Nervous System : Introduction to nervous system, Neuron, Classification of nerve fibers, Properties of nerve fibers, Degeneration & regeneration of nerve fibers, Neuroglia, Receptors, Synapse, Neurotransmitters, Reflex activity, Physiology of pain, Hypothalamus, Electroencephalogram, Physiology of sleep, Epilepsy, cerebrospinal fluid, Autonomic nervous system and ANS tests. Evoked potentials. Cerebral circulation and tests.

Muscle Physiology : Classification of muscles, Structure of skeletal muscles, Properties of skeletal muscles, Changes during muscular contraction, Neuromuscular junction, Electromyogram & disorders of skeletal muscles. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, joints of hands and fingers, Hip joint, Knee joint, ankle joint, joints of foot and toes.

Physiology of Eye and Ear : Structure of the Eye, Visual process, Field of vision, Visual pathway, Pupillary reflexes, Colour vision, Errors of refraction. ERG and EOG. Structure of ear, Auditory defects.

TEXTBOOK:

1. **"Essentials of Medical Physiology"** K Sembulingam & Prema Sembulingam (Jaypee Publications, 2004)

REFERENCE BOOKS:

1. "Concise Medical Physiology" Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd.

CLINICAL INSTRUMENTATION

Subject Code	**:**	**BSI 130**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Bioelectric Signals and Electrodes : Sources of biomedical signals, basic medical instrumentation system, PC based medical instruments, General constraints in design of medical instrumentation systems, origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.

Biomedical Recording Systems & Recorders : Electrocardiograph-block diagram, ECG leads, effects of artifacts, multi-channel, ECG machine, Vectorcardiograph, Phonocardiograph-origin of heart sounds, microphones and amplifiers for PCG, Electroencephalograph- block diagram, computerized analysis of EEG, Electromyograph, biofeedback instrumentation.

Patient & Foetal Monitoring Systems: Cardiac monitor, bedside patient monitoring system, measurement of heart rate-average and instantaneous heart rate meters, measurement of pulse rate, Blood pressure measurement: Direct method, indirect method-automatic pressure measurement using Korotkoff's method, differential auscultatory technique, oscillometric method, ultrasonic Doppler shift method, arrhythmia monitor, exercise

stress testing-treadmill test & bicycle test, ambulatory monitoring-data recording, replay and analysis, Fetal monitoring-Abdominal fetal ECG, fetal phonocardiogram, FHR measurement from ultrasound.

Oximeters, Blood Flow & Cardiac Output Measurement : Oximetry- In-vitro & in-vivo, ear oximetry, pulse oximetry, skin reflectance oximeters, intravascular oximeter. Electromagnetic blood flowmeter- principle, square wave electromagnetic flowmeter, Doppler shift ultrasonic flowmeter, flow measurement by Doppler imaging, NMR & Laser Doppler flowmeter, Cardiac output measurement- Indicator & dye dilution technique, impedance method, ultrasound method.

Respiratory Diagnostic & Therapeutic Instruments : Pulmonary function measurement measurements-respiratory volumes & capacities, compliance & related pressures, dynamic respiratory parameters, basic spirometer, ultrasonic spirometer, pneumotacometer- Fleish & turbine type, measurement of volume-flow volume curve, nitrogen washout technique.

Pacemakers & Defibrillator: Need for cardiac pacemaker, external pacemaker, implantable pacemakers-types, ventricular synchronous demand pacemaker, programmable pacemaker, power sources for implantable pacemakers. Need for defibrillator, DC defibrillator, automatic external defibrillator, implantable defibrillators

Advanced Diagnostic & Therapeutic Instruments : Principle of surgical diathermy & surgical diathermy machine, Electrodiagnosis-Electrotherapy-functional block diagram and working, interferential current therapy. Artificial kidney-Principle and haemodialysis machine. Lithotriptors- principle, modern lithotriptor-block diagram and working. Anesthesia-Need for anesthesia, delivery of anesthesia, anesthesia machine. Infusion pumps-principle and programmable volumetric infusion pump. Principle of endoscopy and laproscopy.

TEXTBOOK :

1. **"Handbook of Biomedical Instrumentation"** R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003

REFERENCE BOOKS:

1. **"Biomedical Instrumentation and Measurement"** Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.
2. **"Biomedical Transducers and Instruments"** Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
3. **"Introduction to Biomedical Equipment Technology"** Joseph J. Carr and John M. Brown, 4th Edition, Prentice Hall, 2001.

REAL TIME SIGNAL PROCESSING

Subject Code	**:**	**BSI 141**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Review of Basics : Convolution, Correlation, Transforms - Fourier, Z, DFT, and FFT, FIR filter design using window method.

Real Time Transforms : Discrete Cosine Transform, Walsh Transform, Hadamard Transform and Wavelet Transform.

Multirate Signal Processing : Concepts of multirate signal processing, Software implementation of sampling rate converters – decimators and interpolators, Sample rate conversion using polyphase filter structure.

Adaptive Digital Filters : Concepts of Adaptive filtering, Wiener filter theory, LMS adaptive algorithm, Recursive least square algorithm, Applications – Adaptive filtering of Ocular artifacts from human EEG and Fetal monitoring.

Digital Signal Processors : Fixed point and Floating point digital signal processors, Architecture of TMS C54XX processor, Addressing modes, Implementation of DSP algorithms: Convolution, correlation, FIR filter, IIR filter, Decimation and Interpolation techniques, FFT processing, Adaptive filtering (LMS algorithm).

Laboratory Experiments:

1. Sampling theorem verification
2. Linear convolution and circular convolution
3. Auto correlation and cross correlation
4. Linear convolution using FFT
5. Linear correlation using FFT
6. Spectrum using FFT
7. Design & test FIR filter using windowing method(hamming window high pass and low pass)
8. Design & test FIR filter using windowing method(kaiser window high pass and low pass)
9. Design and test Butterworth first order and second order low pass filter
10. Design and test Butterworth first order and second order High pass filter
11. Design and test chebyshev first order and second order low pass filter
12. Design and test chebyshev first order and second order High pass filter.

TEXT BOOKS:

1. **"Modern Digital Signal Processing"**, Roberto Cristi, Thomson Publishing.
2. **"Digital Signal Processing"**, Emmanuel C Ifeachor and Barrie W Jervis, 2nd Edition, Pearson Education 2004.
3. **" Real time digital signal processing: Fundamentals, Algorithms and implementation using TMS processor ",** V.Udayashankara, PHI, New Delhi, 2010.

REFERENCE BOOKS:

1. **"Digital Signal Processing"**, Avtar Singh and S Srinivasan, Thomson Publishing 2004, Singapore
2. **"Optimum Signal Processing"**, S J Orfanides, Second edition, McGraw Hill, 1989.
3. **"Digital Signal Processors"**, B Venkataramani and M Bhaskar, TMH, New Delhi 2002
4.

BIO-MATERIALS & ARTIFICIAL ORGANS

Subject Code	**:**	**BSI 142**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction: Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials

Metallic Biomaterials : Introduction, Stainless steel, Cobalt-Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants,

Ceramic Biomaterials: Introduction, nonabsorbable/relatively bioinert bioceramics, biodegradable/resorbable ceramics, bioreactive ceramics, deterioration of ceramics, bioceramic manufacturing techniques

Polymeric Biomaterials: Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving biocompatibility.

Composite Biomaterials : Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility
Biodegradable Polymeric Biomaterials : Introduction, Glycolide based biodegradable homopolymers polyesters, non-glycolide linear aliphatic polyesters, aliphatic and aromatic polycarbonates, biodegradation properties of synthetic biodegradable polymers,

Tissue Derived Biomaterials: Structure and properties of collagen and collagen-rich tissues, biotechnology of collagen, design of resorbable collagen-based medical implant, tissue engineering for tissue and organ regeneration

Hard Tissue Replacements : Bone repair and joint implants-long bone repair and joint replacements, dental implants- effects of material selection, effects of surface properties, surface chemistry.

Preservation Techniques for Biomaterials : Phase behavior, nonfreezing storage-hypothermic, freeze-thaw technology, freeze-drying, vitrification.

Artificial Organs: Introduction, Substitutive medicine, outlook for organ replacement, design consideration, evaluation process.

Artificial Heart and Circulatory Assist Devices : Engineering design, Engg design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses, Non-blood interfacing implants for soft tissues- sutures and allied augmentation devices, percutaneous and skin implants, maxillofacial implants, eye and ear implants, space filling implants and fluid transfer implants.

Cardiac Valve Prostheses
Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and hemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current trends in valve design, vascular grafts-history, synthetic grafts, regional patency, thrombosis, neointimal hyperplasia, graft infections.

Artificial Kidney: Kidney disease, renal failure, renal transplantation, changes in the body fluids in renal disease, artificial kidney, dialyzers, membranes for haemodialysis, haemodialysis machine, portable kidney machine, peritoneal dialysis equipment-therapy format, fluid and solute removal, peritoneal membrane physiology and transport properties.

Artificial Blood : Artificial oxygen carriers, flurocarbons, hemoglobin for oxygen carrying plasma expanders, hemoglobin based artificial blood.

Artificial Lungs: Cardiopulmonary bypass (heart-lung machine)-principle, block diagram and working, artificial lung versus natural lung. Tracheal replacement devices, laryngeal replacement devices, artificial esophagus

Liver Functions : Hepatic failure, liver support systems, general replacement of liver functions.

Artificial Pancreas : Structure and functions of pancreas, endocrine pancreas and insulin secretion, diabetes, insulin, insulin therapy, insulin administration systems.

Artificial Skin : Vital functions of skin, current treatment of massive skin loss, design principles for permanent skin replacement.

TEXT BOOK :

1. **"Biomedical Engineering Handbook"** Volume1 (2nd Edition), J.D.Bronzino (CRC Press / IEEE Press, 2000).
2. **"Biomedical Engineering Handbook"** Volume 2 (2nd Edition), J.D.Bronzino (CRC Press / IEEE Press, 2000)
3. **"Handbook of Biomedical Instrumentation"** (2nd Edition) R.S.Khandpur (Tata McGraw Hill, 2003)

BIOSENSORS

Subject Code	**:**	**BSI 143**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction : What are Biosensors? Advantages and limitations, various components of biosensors, the growing of biosensor. The biosensor family, the biomolecule ingredients, proteins, enzymes complexes, enzymes kinetics, the proteins of the immune systems.

Transducers in Biosensors : Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminescences - based biosensors.

Application and Uses of Biosensors: Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food. Biosensors for personal diabetes management, application of biosensors to environmental samples. Biochips and their application to genomics.

Semiconductor Electrodes : Measurement of H +**,** Ion selective interfaces, Ion selective electrodes, semiconductor electrodes, MIS structures, semiconductor solution interface, FET, chemical sensitive FETA (CHEMFETA), suspended gate field effect transistor, selectivity via pattern recognition, Ion selective FET (ISFET), reference FET, CHEMFET, assessment of CHEMFETS.

Amperometric Assay Techniques : Analysis of charge transfer, volumetric techniques, potential step techniques, non steady state measurement, and applications of charge transfer measurement of the oxygen electrode.
Source of error – Depletion of sample, non-Faradic current error, selectivity interference from other electro active species, Amperometric electrodes for estimation of Ion concentration, macromolecules system, Redox enzymes, modified electrodes, mediated electron transfer, microelectrode fabrication and application.

Photometric Assay Techniques : Energy transition, ultraviolet and visible absorption spectra, fluorescence and phosphorescence, infra Red transitions, light scattering, Raman scattering, applications of ultraviolet visible spectra, indicator linked bioassay, irrational spectroscopy, the optical transducer, wave guides in sensors, device construction, P^H optical probes, light scattering analysis.

Optical Biosensors & Other Techniques: Indicator labeled bioassay, chemiluminescence, bioluminescence, surface plasma resonance, piezoelectric based sensors and surface acoustic waves.

TEXTBOOKS:

1. **"Biosensors**" Elizabeth A. H Hall - Open University press, Milton Keynes.
2. **"Commercial Biosensors"** Graham Ramsay, John Wiley and son, INC. (1998).

REFERENCES:

1. **"Biosensors edited by AEG CASS"** – OIRL press, Oxford University.
2. **"Transducers and Instrumentation",** Murthy D V S. Prentice Hall, 1995

NEURAL NETWORKS & FUZZY LOGIC IN MEDICINE

Subject Code	**:**	**BSI 144**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Learning and Soft Computing : Examples, basic tools of soft computing, basic mathematics of soft computing, learning and statistical approaches to regression and classification.

Single Layer Networks : Perception, adaptive linear neuron (Adaline) and the LMS algorithm.

Multilayer Perception : Error back propagation algorithm, generalized delta rule, practical aspects of error back propagation algorithm.
Radial Basis Function Networks : ill posed problems and regularization technique, stabilizers and basis functions, generalized radial basis function networks.

Fuzzy Logic Systems : Basics of fuzzy logic theory, mathematical similarities between neural networks and fuzzy logic models, fuzzy additive models.

Support Vector Machines : Risk minimization principles and the concept of uniform convergence, VC dimension, structural risk minimization, support vector machine algorithms.

Case Studies : Neural network based adaptive control, computer graphics.

TEXT BOOKS:

1. Vojislav Kecman, "**Learning and soft computing**", Pearson Education (Asia) Pte. Ltd.2004.
2. S.Haykin, "**Neural networks: A Comprehensive Foundation**"' Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2003.
3. M.T.Hagan, H.B.Demuth and M. Beale, "**Neural Network Design**", Thomson Learning, 2002.

REFERENCE BOOKS:

1. Bart Kosko, "**Neural Networks and Fuzzy Systems"** prentice Hall of India, 2005
2. George J. Klir and Bo yaun, "**Fuzzy sets and Fuzzy Logic:Theory and Application**", Prentice Hall of India, 2001

MICRO AND SMART SYSTEM TECHNOLOGY - 1

Subject Code	**:**	**BSI 151**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Overview and working of MEMS & Microsystems, Micro sensors, Micro actuators, Microsystems design and fabrication

Scaling laws in Miniaturization, Materials for MEMS and Microsystems, Micro manufacturing, LIGA process, Microsystems Design, CAD packages for Microsystems

Introduction to BioMEMS, Microactuators and drug delivery, Emerging BioMEMS technology, Introduction to Nanotechnology, Nano Technology in Biology & Medicine, Nano fabrication towards Biomedical applications.

TEXT BOOKS :

1. Tai Ran Hsu, "**MEMS and Microsystems, Design & Manufacture"**, TMH2002.
2. Mohammed had-el-hak, "**MEMS Introduction & Fundamentals"**, CRC Press.
3. Harisingh Nalwa, "**Nanoscience and Nanotechnology"**, American Scientific Publishers.

REFERENCES :

1. Sergey Edward Lyshevski, "**Nano & MEMS"**, CRC press
2. Nadim Maluf, "**An Introduction to MEMS Engineering"**, Artech House Publishing.
3. Taun-Vo-Dish, "**Nanotechnology in Biology & Medicine methods"**, devices & Applications, CRC

ERGONOMICS

Subject Code	**:**	**BSI 152**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction: Principles, Scope and Application of Ergonomics

Anthropometry: Basic definitions, Body dimensions and importance

Musculo Skeletal Disorders: Muscular energy, Dynamic and static effort, postures, Types of disorders their courses and remedies, fatigue, Boredom.

Workstation Design: Design of furniture and lighting computer and office workstations, Operations theatre equipments and their arrangement, Dental chair, Wheel chair.

Environmental Factors: Effects of noise and vibration on the human body, Remedies- Measurements of vibration and noise levels, effect of temperature and humidity on human body.

TEXT BOOKS:

1. **"Grandjaen, Fitting the task to Man**", Taylor Pub, 1982
2. Sanders, "**Human factors in Engg. & Design"**, MGH, 1993
3. D.Majumdar and W.Selvamurthy, "**Advances in Ergonomics, occupational Health and Safety**", New Age international Ltd.

BIOMECHANICS

Subject Code	**:**	**BSI 153**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Biomechanics Applications to Joint Structure and Function : Introduction to Kinematics; Displacement in space; Force vectors and gravity; Linear forces and concurrent forces; Kinetics of rotary and translatory forces; Classes of levers; Close chain force analysis.
Constitutive Equations : Equations for Stress and Strain; Non-viscous fluids; Newtonian viscous fluids; Elastic solids; Visco-elasticity and its applications in biology.

Joint Structure and Function: Properties of connective tissues; Human Joint design; Joint Function and changes in disease.

Integrated Functions : Kinetics and Kinematics of Poistures; Static and Dynamic Poistures; Analysis of Standing, Sitting and Lying Poistures.

Gait: Gait cycle and joint motion; Ground reaction forces; Trunk and upper extremity motion; internal and external forces, moments and conventions; Gait measurements and analysis.

Force Platform and Kinematic Analysis: Design of force platforms, Integrating force and Kinematic data; linked segment, free-body analysis.
Rheology of Blood: Blood flow in heart, Lung, Arteries and Veins.
Finite Element Analysis in Biomechanics: Model creation, Solution, Validation of results and applications of FEA.
TEXT BOOKS

1. **"Joint Structure and Function, A Comprehensive Analysis",** Pamela K. Levangie and Cynthia C. Norkin, JAYPEE Publications, Fourth Edition, 2006.
2. "**Biomechanics; Mechanical Properties of Living Tissues**",Y. C. Fung Springer Verlag, 1985.
3. "**Biomechanics, Structures and Systems**", A. A. Biewener, Sports Publication
4. "**Biomechanics of Human Motion"**, T. McClurg, Anderson.

.BIOINFORMATICS AND APPLICATIONS

Subject Code	**:**	**BSI 154**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

The Central Dogma : Watson's definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins.
XML (Bio XML) for Bioinformatics : Introduction, Differences between HTML and XML, fundamentals of XML, fundamentals of XML namespaces. Introduction to DTDs, Document type Declarations, Declaring elements, declaring attributes, working with entities XML Schemas, Essential Concepts, working with simple types, working with complex types, Basic namespaces issues.

Perl (Bioperl) for Bioinformatics : Representing sequence data, program to store a DNA sequence, concatenating DNA fragments, Transcription, Calculating the reverse complement in Perl, Proteins, files, reading proteins in files, Arrays, Flow control, finding motifs, counting Nucleotides, exploding strings into arrays, operating on strings, writing to files, subroutines and bugs.

Databases : Flat file, Relational, object oriented databases, object Relational and Hypertext, Data life cycle, Database Technology, Database Architecture, Database Management Systems and Interfaces.

Sequence Alignment Algorithms : Biological motivations of sequence analysis, the models for sequence analysis and their biological motivation, global alignment, local alignment, End free-space alignment and gap penalty, Sequence Analysis tools and techniques.

Phylogenetic Analysis : Introduction, methods of Phylogenetic analysis, distance methods, the neighbor-Joining (NJ) method, The Fitch/ Margoliash method, character-based methods, Other methods, Tree evaluation and problems in phylogenetic analysis.
Clustering, Protein structure visualization and Protein structure prediction.

LABORATORY EXPERIMENTS:

Implementation of the following concepts using programming languages:

1) Sequence Alignment.
2) Database Development.
3) Sequence Searching.
4) Genes prediction.
5) 3D Protein structure visualization.

TEXT BOOKS:

1. **"Bioinformatics Methods and Applications",** S.C.Rastogi, N. Mendiratta, CBS publications, 2004
2. **"Beginning Perl for Bioinformatics"** James D. Tisdall, O'Reilly media, first edition, 2001
3. **"Bioinformatics Computing"** Bryan Bergeron, M.D, Pearson education, 2003
4. **"XML for Bioinformatics**" CERAMI, ERBS

REFERENCE BOOKS:

1. **"Bioinformatics"** D.R. Westhead, J.H. Parish, Viva books private limited
2. **"Bioinformatics"** AttWood, pearson education,2004

ADVANCED BIOMEDICAL SIGNAL PROCESSING

Subject Code	**:**	**BSI 210**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction : General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing, Difficulties in signal acquisition.

Random Processing : Introduction, Elements of probability Theory, Random signal characterization, correlation analysis, The Gaussian process.
ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

ECG Data Reduction : Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques : Karhunen-Loeve Transform, Other data compression Techniques: DPCM, Huffman coding, Data compression Techniques comparison.

Finite Time Averaging : Introduction, finite time estimation of mean value, estimation of variance, correlation, synchronous averaging. Removal of random noise in ECG, Estimation of visual or auditory ERPs

(Event Related Potentials) using synchronous averaging technique, event detection and epoch analysis of EEG in multiple channels using correlation analysis.

Frequency Domain Analysis : Introduction, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG,

Time Series Analysis : Introduction, AR models, MA models, ARMA models. Spectral modeling and analysis of PCG signals.
Spectral Estimation : Introduction, Black tukey method, The peridogram, Pisarenko's Harmonic decomposition, Prony' method, Maximum likelihood method- Capson's spectral estimation, Evaluation of prosthetic heart valves using PSD techniques.

Adaptive Filtering : Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, improved adaptive filtering, Cancellation of 60 Hz interference in ECG, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.

EEG : EEG signal characteristics, Sleep EEG classification and epilepsy.
Laboratory Experiments:

1) Display of static and moving ECG.
2) Down sampling & up-sampling of ECG signal.
3) Detection of QRS complex and heart rate measurement.
4) Auto-correlation and cross correlation of ECG signals.
5) DCT and IDCT of ECG signal.
6) Computation of Convolution and Correlation Sequences.
7) Signal Averaging to improve the SNR.
8) PSD estimation for ECG, EEG and EMG.
9) Design of 50 Hz notch filter for ECG signal and display PSD.
10) Design of IIR filters for ECG(LPF, HPF, BP).
11) Design of FIR filters for ECG.(LPF, HPF, BP).
12) Data Compression Techniques: AZTEC, TP, FAN algorithms.

TEXT BOOKS:

1. **"Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I"),** Arnon Cohen, CRC press.
2. **"Biomedical Signal Analysis case study approach",** Rangaraj M Rangayyan, John Wiley publications.

REFERENCE BOOKS:

1. **"Biomedical Signal Processing Principles and Techniques"** D.C.Reddy, Tata Mc Graw-Hill
2. **"Biomedical Digital Signal Processing",** Willis J. Tompkins, PHI.

DIGITAL IMAGE PROCESSING

Subject Code	**:**	**BSI 220**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Fundamentals: Introduction, Fundamental steps in DIP, A simple image formation model, representing digital images, Spatial & Gray level resolution, Basic relationship between pixels.

Image Enhancement: Point operations, Spatial averaging, Median filtering, Spatial low pass, high pass and band pass filtering, Histogram equalization, Transform operations.

Image Compression: Huffman coding, DFT, DCT, Wavelet coding & JPEG standard.

Image segmentation: Detection of discontinuities, Edge linking and Boundary detection by local processing & global processing using Hough transform, Region based segmentation.

Image Representation and Description: Representation – Chain codes, polygonal approximations, signatures, boundary segments, skeletons, Boundary descriptors – Some simple descriptors, Shape numbers, Fourier descriptors, statistical moments, Regional descriptors – Some simple descriptors, topological descriptors, texture.

Color Image Processing: Color fundamentals, Color models, Pseudo color image processing, Basics of full color image processing, Color transformations- Formulation, complements, histogram processing, Color image smoothing and sharpening, Color image segmentation

Morphological Image Processing : Basic concepts of set theory, Logical operations involving binary images, Dilation and erosion, Opening and closing, The hit-or-miss transformation, Basic morphological algorithms.

Motion Analysis : Introduction, Optical flow – Optical flow computation, Global and local optical flow estimation, optical flow computation approaches, optical flow in motion analysis.

LABORATORY EXPERIMENTS:

The following list of experiments (assignments) to be performed on an image. (Using MATLAB / C Language)

1) Display (reading) of an image.
2) Image Enhancement.
3) Image Compression.
4) Image Segmentation.
5) Image Representation & Description.
6) Color Image Processing.
7) Morphological Image Processing.
8) Motion Analysis.

TEXT BOOKS:

1. **"Digital Image Processing"** Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.
2. **"Fundamentals of Digital Image Processing"** Anil K. Jain. Prentice Hall of India.
3. **"Image Processing, Analysis and Machine Vision"** Milan Sonka, Vaclav Hlavac & Roger Boyle, 2nd Edition.

REFERENCE BOOKS:

1. **"Digital Image Processing"** Rafael C. Gonzalez & Richard E. Woods, First Edition. Pearson Education Inc.
2. **"Practical Algorithms for Image Analysis"** Description, Examples & Codes by Michael Seul, Lawrence O'Gorman, Michel J.Sammon, Cambridge University Press.
3. **"Biomedical Imaging visualization and analysis"** Richard A Robb, John wiley & sons, Inc. publication.

MEDICAL IMAGING

Subject Code	**:**	**BSI 230**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction: Basic imaging principle, Physical signals, Imaging modalities-Projection radiography, Computed Tomography, Nuclear medicine, Ultrasound imaging, Magnetic Resonance Imaging.

X-Ray : Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, Dynamic spatial reconstructor, Electron beam CT, X-Ray image characteristics, Biological effects of ionizing radiation.

Computed Tomography : Conventional tomography, Computed tomography principle, Generations of CT machines – First, Second, Third, Fourth, Fifth, Sixth & Seventh, Projection function, Reconstruction algorithms – Back Projection Method, 2D Fourier Transform Method, Filtered Back Projection Method, Iteration Method, Parallel Beam Reconstruction, Fan Beam Reconstruction, Helical CT Reconstruction.

Ultrasound : Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Transducer Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging, Echocardiography

Radio Nuclide Imaging: Interaction of nuclear particles and matter, Nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET.

Magnetic Resonance Imaging : Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager. Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to Functional MRI.

TEXT BOOKS:

1. "**Principles of Medical Imaging**", K Kirk Shung, Michael B Smith & Benjamim M W Tsui, Academic Press inc.
2. "**Medical Imaging Signals and Systems**", Jerry L Prince & Jonathan M Links, Pearson Prentice Hall.

REFERENCE BOOK:

1. "**Hand Book Of Biomedical Instrumentation**", R S Khandpur, Tata McGraw Hill Publication, Second Edition.
2. "**Basics of MRI**", Ray H Hashemi & William G Bradley Jr, Lippincott Williams & wilkins.
3. "**Diagnostic Ultrasound Principles & Instruments"**, 5th Edition, Frederick W Kremkau.
4. "**2D Echocardiography**", Jay N Schapira, Williams & Wilkins.

SPEECH SIGNAL PROCESSING

Subject Code	**:**	**BSI 241**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Digital Models for Speech Signals : Process of Speech Production, Acoustic phonetics, Digital models for Speech signals.

Time Domain Models for Speech Processing: Time dependent processing of speech, Short time Energy and average magnitude, Short time average zero crossing rate, Speech vs. silence discrimination using energy and zero crossing, Pitch period estimation using parallel processing approach, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function.

Short Time Fourier Analysis : Introduction, Definitions and properties, Fourier transform interpretation, Linear filtering interpretation, Sampling rates of X(ejw) in time and frequency, Filter bank summation method of short time synthesis, Cepstrum analysis and applications, Spectrographic displays.

Digital Representations of the Speech Waveform : Sampling speech signals, Review of the statistical model for speech, Instantaneous quantization, Adaptive quantization, General theory of differential quantization, Delta modulation, Differential PCM, Comparison of systems.

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Applications of LPC parameters.

Speech Synthesis : Principles of Speech synthesis, Synthesis based on waveform coding, Synthesis based on analysis synthesis method, Synthesis based on speech production mechanism, Synthesis by rule, Text to speech conversion.
Speech Recognition : Principles of Speech recognition, Speech period detection, Spectral distance measures, Structure of word recognition systems, Dynamic time warping (DTW), Word recognition using phoneme units. Theory and implementation of HMM

Speech Processor : Introduction to Voice synthesis digital ICs, SP0256B and SP0256-AL2 Speech synthesis processor, TSP 5220C Voice synthesis chip from Texas Instruments.

Laboratory Experiments:

1. To conduct a suitable experiment to determine the Pitch (time domain) and formant frequencies
2. Examine effect of window shape and duration on energy, autocorrelation or speech spectrogram.
3. Write and test a suitable code for cepstrally smoothed spectrum from speech signal
4. To conduct a suitable experiment to determine LPC using autocorrelation and covariance method
5. To develop a suitable program for analyzing voiced/ unvoiced detector.
6. To develop a program to test beginning and endpoint of a detector.
7. Write and test a suitable code for formant analyzer.
8. Design and execute a program to perform Waveform coder- e.g. ADM, ADPCM etc.
9. Design and execute a program to perform Transform LPC parameters to alternate parameter sets and show statistical properties.
10. Write and test a suitable code for Compare LPC, FFT, and Cepstrally smoothed spectra.

TEXT BOOKS:

1. **"Digital Processing of Speech Signals"**, L R Rabiner and R W Schafer, Pearson Education 2004.
2. **"Digital Speech Processing, Synthesis and Recognition**", Sadoaki Furui, Second Edition, Mercel Dekker 2002.
3. **"Designing with speech processing chips"**, Ricardo Jimenez, Acaademic press, INC 1991.

REFERENCE BOOKS:

1. **"Introduction to Data Compression"**, Khalid Sayood, Third Edition, Elsivier Publications.
2. **"Digital Speech"**, A M Kondoz, Second Edition, Wiley Publications

WAVELETS IN BIOMEDICAL ENGINEERING

Subject Code	**:**	**BSI 242**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Wavelet Transforms: Overview of WT, fundamentals-FT, STFT, resolution, Multi resolution analysis-CWT, DWT WAVELETS IN MEDICAL IMAGING AND TOMOGRAPHY

Applications of wavelet shrinkage to tomography
Wavelet denoising of functional MRI data
Statistical analysis of image differences by wavelet decomposition
Feature extraction in digital mammography
Adapted wavelet techniques for encoding MRI diagnosis of coronary artery disease using wavelet based neural networks.

TEXT BOOKS:

1. **"Tutorial on Wavelets"**, part I-IV, RobiPolikar (WWW.Rohen University.edu)

"Wavelets in medicine and biology" Akram Aldroubi and Michael Unser. CRC press

COMPUTERS IN TOMOGRAPHY

Subject Code	**:**	**BSI 243**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction to principles of tomography and applications. Basic concepts and a few applications of tomography.
Fundamentals of integral transforms and special functions. Linearity, Hankels function and its properties.

Fundamental of signal processing: Continuous and discrete signal processing, 1-D functions, Linear operations, Fourier representation, DFT, sampling image processing, point sources, delta functions, Linear shift invariant operations, Fourier analysis. Properties of Fourier transforms, 2D Finite Fourier transform.

Tomography Imaging: Line integrals and projections, Radon Transform and properties, Fourier slice theorem, basic idea about reconstruction algorithms for parallel projections, back projection, filtered back projection techniques.
Computer Implementation of Re-Construction Algorithms: Implementation of filtered back projection for parallel beam, fan beam projections. Study of merits and demerits of different beam geometries. Algebraic reconstruction techniques, Fourier reconstruction techniques.

3D Image Reconstruction: Helical or spiral scan trajectory for 3D images, cone beam projections on circular and spiral trajectory for 3D reconstructions.

Noise in CT Reconstructed Images: Sources of noise in CT images, discrete and continuous cases, system artifacts, noise in specific application of CT. Image reconstruction with incomplete and noisy data.

Application Areas of CT: Introduction to X-ray tomography. Emission computer tomography, Magnetic resonance imaging, ultra sonic computed tomography.

TEXT BOOKS:

1. Avinash C. Kak and Malcolm Slaney, "**Principles of Computerized Tomographic Imaging**", IEEE Press, 1988.

REFERENCE BOOKS:

1. Willi. A. Kalender, "**Computer Tomography; Fundamentals, System Technology, Image Quality, Applications**", Wiley-VCH, 2nd Edition, 2006.
2. Steward C. Bushong, "**Computed Tomography**", Mc GrawHill Medical, 1st Edition, 2004.
3. Herman G.T., "**Image Reconstruction From Projections, implementation and applications, Topics in Applied Physics**", Vol 32, Springer-Verlag, 1979.
4. Barret H.H. and Swindel W., "**Radiological Imaging**", Vol II, Academic Press, 1981.

PATTERN RECOGNITION

Subject Code	**:**	**BSI 244**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

1 .Introduction: Machine perception, an example; Pattern Recognition System; The Design Cycle, Learning and Adaptation.

2.Probability: Introduction to probability, conditional probability, Random Variables, The Binomial and Poisson distribution, Joint Distribution and Density, Moments of Random Variables, Estimation of Parameters from Samples,
(8hrs)

3. Bayesian Decision Theory: Minimum Error Rate Classification, Classifiers, Discriminant functions, and decision surfaces; the normal density; Discriminant functions for the normal density.

4. Maximum-likelihood and Bayesian Parameter Estimation: Introduction, Maximum-likelihood estimation; Bayesian Estimation; Bayesian parameter estimation: Gaussian Case, general theory; Hidden Markov Models.

5. Processing of waveforms and Images: Introduction, Gray Level Scaling Transformations, Equalization, Geometric Image Scaling and Interpolation, Smoothing Transformations, Edge Detections, Line Detection And Template Matching.

6 Clustering: Introduction, Hierarchical clustering, Partitional clustering.

7. Introduction to Biometric Recognition: Biometric Methodologies: Finger Prints; Hand Geometry; Facial Recognition; Iris Scanning; Retina Scanning;

Text Books:

1) Richard O. Duda, Peter E. Hart, and David G.Stork: Pattern Classification, 2nd Edition, Wiley-Interscience, 2001.

2) Earl Gose, Richard Johnsonbaugh, Steve Jost: Pattern Recognition and Image Analysis, Pearson Education, 2007.

Reference Books:

K. Jain, R. Bolle, S. Pankanti: Biometrics: Personal Identification in Networked Society, Kluwer Academic, 1999.

MICRO AND SMART SYSTEM TECHNOLOGY – 2

Subject Code	**:**	**BSI 251**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Smart system technology with special reference to Bio Mems. To be coverd from journal papers.

VIRTUAL BIO-INSTRUMENTATION

Subject Code	**:**	**BSI 252**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Basic Concepts: Data Acquisition (DAQ) basics**,** Lab VIEW Basics, Bio Bench basics.

Biopotentials: Typical Laboratory Workstation, Lab Layout and Design, Generic Instrumentation/ Data Acuisition Issues.

Electroneurology : Physiological basics, Experiment set up, Di section, Nerve chamber preparation, generic VI Development, Experiment descriptions, Trouble shooting the nerve recording.

Neuromuscular Electrophysiology (Electromyography) : Physiological basis, Experiment set up, Experiment descriptions, Trouble shooting the nerve –Muscle Preparation.

Cardiac Electrophysiology(Electrocardiology) : Physiological basis, Experiment descriptions.

Cardiopulmonary Dynamics : Typical Laboratory Workstation, Generic Instrumentation/Data Acquisition Issues.

Pulmonary Function : Physiological Basis, Experiment setup, Pulmonary DAQ system operation.

Lung Tissue Viscoelastance : Experiment setup, Experiment Description.

Cardiovascular Hemodynamics : Physiological Basis, Canine Cardiovascular, pressure measurements.

A Cardiovascular Pressure – Dimension Analysis System :System setup, Data Acquistion and Analysis, Clinical Significance.

Medical Device Development Applications :The Endotester – A Virtual Instrument –Based Quality control and Technology, Assessment System for surgical Video Systems : Introduction, Materials and Methods, Endoscope Tests, Results, Discussion.

FluidSense Innovative IV Pump Testing : Introduction, The test System, Training Emulator.

Healthcare Information management Systems :

Medical Informatics : Defining medical informatics, Computers in medicine, Electronic Medical record, Computerized physician order entry, Decision support.

Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation.
Managing Disparate Information :ActiveX, ActiveX Data Objects(ADO), Dynamic Link Libraries, Database Connectivity, Integrated Dashboards.

Note : Supporting experiments to be carried out whereever necessary**.**

TEXTBOOKS:

"Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW. ,by JON B. OLANSEN and ERIC ROSOW, Prentice Hall Publication, 2002.

ARM EMBEDDED SYSTEM DESIGN

Subject Code	**:**	**BSI 253**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Introduction to embedded systems, Processor and memory organization.
ARM embedded system, ARM processor fundamentals.

Introduction to ARM instruction set, Introduction to thumb instruction set

Writing and optimizing ARM assembly code, Optimized primitives

Introduction to DSP on the ARM, FIR filters, IIR filters, DFT

Exception and interrupt handling, Embedded operating systems

Advanced DSP and SIMD support in ARMv6, System and multiprocessor support additions to ARMv6 implementations, Future technologies beyond ARMv6.

TEXT BOOKS:

1. **"ARM system developers guide"**, Andrew N Sloss, Dominic Symes and Chris wright, Elsevier, Morgan Kaufman publishers, 2008.
2. **"Embedded Systems"**, Rajkamal, Tata Mcgraw-Hill publishers, 2008

REFERENCE BOOKS:

1. **"Embedded system design"**, Frank vahid/Tony givargis, John wiley &sons, 2003.
2. **"Embedded/Real time systems, Real-Time systems"**, Dr.K.V.K.K Prasad, Dreamtech press, 2004.
3. **"Embedded Linux system design and development"**, P Raghavan, Amol lad, Sriram Neellakandan, Auerbach publications 2006.

THEORY & DESIGN OF BIO-MEDICAL INSTRUMENTS

Subject Code	**:**	**BSI 254**	**IA Marks**	**:**	**50**
No of Lecture Hrs/Week	**:**	**04**	**Exam hours**	**:**	**03**
Total No.of Lecture Hours	**:**	**52**	**Exam Marks**	**:**	**50**

Analytical methods, Passive Transducers

Piezoelectric Transducer

Ultrasonic instruments, Electrodynamic & Magnestrictive transducers

Force balance transducers, Fiber optic transducers

Signal processing Circuitry & Microprocessors

Biotelemetry

Frequency discriminators & Phase locked loops

TEXT BOOK:

1. Walter Welkowitz and others, " **Biomedical Instruments- Theory and Design**" Academic Press 1992,II edition

REFERENCE BOOKS:

1. R.S, C. Cobbold, "**Transducers for biomedical measurements: Principle and practice**", John Wiley 1974
2. Tatsno Togawa, Toshiyo Tarnura, P.Akeoberg " **Biomedical transducers and Instruments**" CRC press 1997