M.TECH

BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

ACADEMIC YEAR 2013-15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

I YEAR I SEMESTER

Code	Group	Subject	L	T/P	C
	Core	Medical Image Processing	3	1	3
	Core	Real Time Signal Processing	3	1	3
	Core	Virtual Instrumentation	3	1	3
	Core	Bio Sensors	3	1	3
	Elective-I	Physiology For Engineers * Bioinformatics And Applications Electronic System Design	3	1	3
	Elective-II	Clinical Instrumentation * Neural Networks And Fuzzy Logic Biostatistics	3	1	3
	Lab	Biomedical and Virtual Instrumentation Lab	-	3	2
		Seminar	-	3	2
		Total Credits (6 Theory + 1 Lab)			**22**

***Compulsory for students with ECE & EIE background**

I YEAR II SEMESTER

Code	Group	Subject	L	T/P	C
	Core	Advanced Biomedical Signal Processing	3	1	3
	Core	Advanced Medical Imaging	3	1	3
	Core	Fiber Optics And Laser Instrumentation	3	1	3
	Core	Digital Signal Processors And Architectures	3	1	3
	Elective-III	Adaptive Signal Processing Sensors and Actuators Design and Analysis of Signal Conditioning Circuits	3	1	3
	Elective-IV	Biomems And Nanotechnology Speech Processing Rehabilitation Engineering	3	1	3
	Lab	Advanced Medical Signal & Image Processing Lab	-	3	2
		Seminar	-	3	2
		Total Credits (6 Theory + 1 Lab)			**22**

II YEAR – I SEMESTER

Code	Group	Subject	L	T/P	C
		Comprehensive Viva	-	-	2
		Project Seminar	-	3	2
		Project Work	-	-	18
		Total Credits			**22**

II YEAR – II SEMESTER

Code	Group	Subject	L	P	C
		Project work and Seminar	-	-	22
		Total Credits			**22**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

MEDICAL IMAGE PROCESSING

UNIT-I

Digitized image functions, Dirac distributions, convolution, Fourier transform, Images as linear system. Image digitization, sampling, Quantization, color images. Digital image properties, Metric and topological properties, Histogram visual perception, Image quality, Noise. Data structures for image analysis, data representation, traditional and hierarchical data structures.

UNIT-II

Image Enhancement. Contrast manipulation, histogram equalization, Laplacian derivatives, Sobel and Klisch operators, rank operators –textural analysis. Image pre processing – pixel brightness transformations, Geometric transformations, local pre processing, Image restoration. Imaging filters.

UNIT-III

Thresholding and Segmentation. Detection methods, optimal thresholding, multi-spectral thresholding. Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches.

UNIT-IV

Restoration. Deterministic, geometric linear filtration, inverse filtering, power spectrum equalization, stochastic. Wiener filtering. Registration, anatomy based, object based, scene based.

UNIT-V

Mathematical morphology. Basic morphological concepts, Morphological principles: Binary dilation and erosion, Gray scale dilation and erosion, skeletons and object marking, graundometry, Morphological segmentation and water sheds.

TEXTBOOKS:

1. John C Russ, *The image processing handbook*, CRC and IEEE press –1999.
2. Milan Sonka, Vaclav Hlavac,Roger Boyle, *Image processing, analysis and machine vision*,

2nd edition,Brooks/Cole publishing Co., 1999.

REFERENCES:

1. Jayaram, Kudupa and Gabor,T Herman, *3D imaging in medicine*, 2nd edition, CRC press, 2000.
2. Craig A.Hindley, *Practical image processing in C*, John Wiley and Sons 1991.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

REAL TIME SIGNAL PROCESSING

UNIT I

Review of Basics: Discrete time processing of continuous signals - Structure of a digital filter; Frequency domain analysis of a digital filter; Quantization error; Sigma and Sigma Delta Modulation. Fourier analysis – DFT, DTFT, DFT as an estimate of the DTFT for Spectral estimation. DFT for convolution, DFT/DCT for compression, FFT. Ideal Vs non ideal filters, FIR and IIR Filters Digital Filter Implementation; Elementary Operations.

UNIT II

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

Digital Filters –, State Space realization, Robust implementation of Digital Filters, Robust implementation of equi – ripple FIR digital filters.

UNIT III

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

UNIT IV

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.

UNIT V

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).

TEXT BOOKS:

1. Roberto Cristi, "**Modern Digital Signal Processing**", Cengage Publishers, India, (erstwhile Thompson Publications), 2003.

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. S.K. Mitra, “**Digital Signal Processing: A Computer Based Approach**”, III Ed, Tata McGraw Hill, India, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

VIRTUAL INSTRUMENTATION

UNIT- I

Virtual Instrumentation: An introduction

Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

UNIT- II

VI programming techniques:

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT- III

Data acquisition basics:

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. DC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT -IV

VI Interface requirements:

Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Fire wire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT- V

VI toolsets: Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXTBOOKS

1. LabVIEW Graphical Programming, Gary Johnson, Second edition, McGraw Hill, Newyork, 1997.
2. LabVIEW based Advanced Instrumentation Systems, S. Sumathi and P. Surekha, Spinger.

REFERENCES

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000.
2. WEB RESOURCES: www.ni.com.
3.LabVIEW for everyone, Lisa K. wells & Jeffrey Travis Prentice Hall, New Jersey, 199

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

BIOSENSORS

UNIT-I

Principles of transduction and measurement, Sensor Classification, Medically significant measurands- strain, force, pressure, acceleration, flow, volume, temperature and biopotentials. Functional specifications of medical sensors; static and dynamic characteristics of measurement systems. Primary sensors.

UNIT – II

Resistive sensors. Potentiometers, Strain gages, RTDs, Thermistors, LDR. Signal conditioning. Wheatstone bridge, balance and deflection measurements. Instrumentation amplifier. Interference types and reduction. Shield grounding. Isolation amplifiers.

UNIT-III

Reaction variation and electromagnetic sensors. Capacitive sensors, inductive sensors, LVDT, electromagnetic sensors. Signal conditioning, AC bridges, AC amplifiers, electrostatic shields, carrier amplifiers, phase-sensitive detectors.

UNIT-IV

Self-generating sensors. Thermoelectric sensors, thermocouples, piezoelectric sensors, photovoltaic sensors. Signal conditioning. chopper and low-drift amplifiers, Noise in op-amps. Digital sensors. Telemetry and data acquisition.

UNIT-V

BioMicroElectroMechanical Systems (BioMEMS). Principles, design, fabrication and application of micro- and nano-devices to instrument and control biological molecules, living cells, and small organisms. Development of micro fabricated systems, lab-on-a-chip, and micro- and nano-biosensors.

TEXTBOOK:

1. Ramon Pallas-Areny and John G. Webster, *Sensors and signal conditioning*, John Wiley and Sons, 1991.
2. **DVS Murthy**, **Transducers** for **Instrumentation** Systems, 2nd edition, Prentice Hall of India Ltd, 2004

REFERENCES:

1. John G. Webster, *Medical Instrumentation-Application and Design*, John Wiley and Sons Inc., 3rd Ed., 2003.
2. Rangan C.S., Sarma G.R., and Mani V.S.V., "Instrumentation devices and system", Tata McGraw Hill Publishing Company limited, New Delhi, 2006.
3. A.P.F. Turner, I. Karube & G.S. Wilson, "Biosensors : Fundamentals & Applications", Oxford University Press, Oxford, 1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

PHYSIOLOGY FOR ENGINEERS
(ELECTIVE-I)

UNIT I

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

UNIT II

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.

UNIT III

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.

UNIT IV

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

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.

UNIT V

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.

TEXTBOOK:

1. Principles of Anatomy and Physiology by Gerard J. Tortora and Bryan H. Derrickson (Wiley 13th Edition)
2. J Gibson; Modern Physiology & Anatomy for Nurses; Black-well Scientific Publishers, 1981.

REFERENCES:

1. Best and Taylor, Physiological basis of Medical practice, *The Living Body*, B.I. Publication, 1980.
2. Walter Boron, Textbook of Medical Physiology , Publisher: W.B. Saunders Company, 2008
3. **"Concise Medical Physiology"** Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

BIOINFORMATICS AND APPLICATIONS (ELECTIVE-I)

UNIT I

The Central Dogma & XML (Bio XML) for Bioinformatics: Watson's definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins.

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.

UNIT II

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.

UNIT III

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

UNIT IV

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.

UNIT V

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.

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

REFERENCE BOOKS:

1. **"Bioinformatics"** D.R. Westhead, J.H. Parish, Viva books private limited, New Delhi (2003)

2. **"Bioinformatics"** AttWood, pearson education, 2004

3. **"Bioinformatics Computing"** Bryan Bergeron, M.D, Pearson education, 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

ELECTRONIC SYSTEM DESIGN
(ELECTIVE-I)

UNIT-I: Analog and digital circuit design of circuits for biomedical applications using operational amplifiers, data acquisition, conversion, and interface to microcomputers. Patient safety, patient isolation circuits. Operating principles of various types of patient isolation circuitry. Most suitable isolation circuit for a given application. Test isolation circuits.

UNIT-II : Data acquisition, Sample and Hold Conversion, Multi Channel acquisition, High speed sampling in ADC, Selection of drive amplifier for ADC performance, Gain setting and level shifting, ADC input protection, Multichannel channel applications for data acquisition systems, External protection of amplifiers, High speed ADC architectures.

UNIT-III: Interference and noise reduction techniques. Types of noise-Thermal noise, shot noise, excess noise, Burst, Internal noise in OPAMPs, Noise issues in high speed applications, . Causes of noise and interference encountered in medical equipment. Manifestation of noise or interference. Techniques for minimizing the impact of noise or interference when using various types of medical equipment.

UNIT-IV : Hardware approach to digital signal processing, Coherent and non-coherent sampling, Digital signal processing techniques, DSP hardware, ALU, Multipliers, accumulators, data address generators, serial ports, system interfacing ADC's and DAC's to DSPs. Interfacing IO ports to DSPs.

UNIT-V: Use of telemetry in a medical environment.. Available frequency bands and licensing requirements for RF telemetry environments. Typical telemetry methods used in medical applications. Common problems with telemetry installations. Battery management procedures. Types of batteries used in medical equipment. Typical shelf life of common batteries. Applications for common batteries. Techniques to improve life of batteries. Test equipment for correct function after battery replacement.

TEXTBOOKS:

1. Halit Eren, *Electronic portable instruments-Design and applications*, CRC Press, 2004.
2. Robert B. Northrop, *Analysis and application of analog electronic circuits to biomedical instrumentation*, CRC Press, 2004.

REFERENCE:

1. Reinaldo J . Perez, *Design of medical electronic devices*, Academic press, 2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

CLINICAL INSTRUMENTATION
(ELECTIVE-II)

UNIT I

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.

UNIT II

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.

UNIT III

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.

UNIT IV

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

UNIT V

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
2. Medical Instrumentation Application and Design by John G. Webster, Willey, 4th edition.

REFERENCE BOOKS:

1. **"Introduction to Biomedical Equipment Technology"** Joseph J. Carr and John M. Brown, 4th Edition, Prentice Hall, 2001.
2. **Principles** of Applied Biomedical **Instrumentation**, 3rd Edition. L. A. **Geddes**, L. E.**Baker, Willey,2008**
3. **"Biomedical Transducers and Instruments"** Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, 1st edition, CRC Press, 1997.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

NEURAL NETWORKS AND FUZZY LOGIC
(ELECTIVE-II)

UNIT – I

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

UNIT – II

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

Error back propagation algorithm, generalized delta rule, practical aspects of error back propagation algorithm.

UNIT – III

Radial Basis Function Networks: ill posed problems and regularization technique, stabilizers and basis functions, generalized radial basis function networks.

UNIT – IV

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

UNIT – V

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

TEXT BOOKS:

1. Artificial Neural Network, Dr.B. Yegnanarayana, Pearson Edu in, PHI,New Delhi,1999.
2. Introduction to Artificial Neural system, J.M.Zurada, Jaico Publications,1994
3. Bart Kosko, "**Neural Networks and Fuzzy Systems"** prentice Hall of India, 2005

REFERENCE BOOKS:

1. S.Haykin, "**Neural networks: A Comprehensive Foundation**"' Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2003.
2. Vojislav Kecman, "**Learning and soft computing**", Pearson Education (Asia) Pte. Ltd.2004.

3. M.T.Hagan, H.B.Demuth and M. Beale, "**Neural Network Design**", Thomson Learning, 2002.
4. George J. Klir and Bo yaun, "**Fuzzy sets and Fuzzy Logic:Theory and Application**", Prentice Hall of India, 2001

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **I SEMESTER**

BIOSTATISTICS
(ELECTIVE-II)

UNIT- I

Concepts of Biostatistics. Basic statistical measures, measures of central tendency, measures of dispersion, variance, standard deviation, properties of probability, probability distributions, sampling distributions.

UNIT- II

Estimation and hypothesis testing. confidence intervals for data, t distribution, determination of sample size for estimating means and proportions. Hypothesis testing for a single population mean/proportion difference between two population means/proportions, sample size to control type I and type II errors.

UNIT- III

Analysis of variance. The completely randomized design, random sized complete block design, repeated measures design.

UNIT- IV

Regression and correlation. Simple linear regression model, regression equation, the correlation model, multiple linear regression model, multiple regression equation, multiple correlation model, additional techniques of regression analysis.

UNIT- V

Chi-square distribution, tests of good fit, independence, homogeneity, non-parametric statistical procedures, regression analysis.

TEXTBOOK:

1. Stanton A. Glantz, *Primer of biostatistics,* Mc Graw Hill , 2nd Ed.
2. Wayne S. Daniel, *Biostatistics: A foundation for analysis in the health sciences*, John Wiley & Sons, 6th Ed.

REFERENCE:

1. Text book of Biostatistics,A.K.Sharma,DPH Mathematics series,2005
2. Bernard Rosner's Fundamentals Of **Biostatistics, 6th** edition, Thomson Coporation, 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) I SEMESTER

BIOMEDICAL AND VIRTUAL INSTRUMENTATION LAB

LIST OF EXPERIMENTS

Biomedical Instrumentation

1. Design of ECG Amplifier using Instrumentation Amplifier
2. ECG Recording and Heart rate measurement
3. Study of Electrical activities of Skeletal Muscles
4. Respiration Rate Measurement.
5. Demonstration of Defibrillator, Pacemaker, Heart lung machine, Hemodialysis and Short wave Diathermy.

Virtual Instrumentation

1. Design of decimal counter and function generator
2. Design of filters using NIELVIS
3. Signal processing with speed 33 (Speech recording and analysis)
4. Image processing application with vision assistant
5. Profiling VI Execution time and memory usage
6. Extending Virtual memory usage for 32-bit windows.
7. Characteristics of an ideal filter.
8. Comparison of FIR and IIR filters.
9. Non linear filter
10. Selection and design of a digital filter design.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

ADVANCE BIOMEDICAL SIGNAL PROCESSING

UNIT-I Fundamentals of Discrete-Time signals and systems:
Concepts of system, signal. Sampling Process. Impulse Response. Z-Transform, Discrete Transfer function, Discrete Fourier Transform(DFT), Fast Fourier Transform(FFT). Medical Applications

UNIT-II The Electroencephalogram(EEG):
Applications, Signal Processing, Modeling and Artifacts. Nonparametric and Model-based spectral analysis, EEG segmentation, Joint Time-Frequency Analysis. Evoked Potential Modalities, Noise Characteristics, Noise reduction by Ensemble Averaging and Linear Filtering, Single-Trail Analysis and adaptive Analysis Using Basis Functions

UNIT-III Wavelets:
Continuous Wavelet Transform. Discrete wavelet transform. Reconstruction. Recursive multi resolution decomposition. Types of wavelets-Haar wavelet, Daubechies wavelet, Biorthogonal wavelet. Coislet wavelet, Morlet wavelet, Mexican Hat wavelet, Symlet wavelet. Medical applications

UNIT-IV The Electromyogram (EMG):
The electrical Activity of Muscles, Amplitude Estimation in the surface EMG, Spectral Analysis of the surface EMG, Conduction velocity Estimation, Modeling the EMG, EMG Signal Decomposition

UNIT-V The Electrocardiogram(ECG):
Heart Rhythms, Heart beat Morphologies, Noise and Artifacts, Baseline Wander, Power line interference, Muscle Noise Filtering, QRS Detection, Wave Delineation, Data Compression, Heart Rate Variability, Acquisition and RR Interval conditioning , Spectral Analysis of Heart Rate Variability.

TEXTBOOKS:
1. Leif Sornmo and Pablo Laguna, Bioelectrical Signal Processing in Cardiac and Neurological Applications, Academic Press, 2005
2. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice-Hall, 1993.

REFERENCES:
1. Rangaraj M. Rangayyan, Akay Metin(Editor),Biomedical Signal Analysis: A Case Study Approach, Wiley Interscience, 2001.
2. Roberto Cristi, Modern Digital Signal Processing

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

ADVANCED MEDICAL IMAGING

UNIT-I Basic Medical Imaging Modalities:
X-ray, CT , Ultrasound, MRI, PET-CT, SPECT-CT, Gamma Camera, Catheterization Lab. Aspects of light imaging, convolutions and transforms, photometry lenses and depth of field, Image perception and 3D Imaging, Image acquisition, Display, Image processing operations, scanning & segmentation.

UNIT-II Computed Tomography:
Basic concepts of CT , Non Spiral CT technology, Concepts of Spiral CT Scanner , Multi Slice spiral technology , Various Peripheral devices. Applications:Multiplanar Reconstruction, Maximum Intensity Projection, 3D, CT Angio, Osteo , Dental, Perfusion (Body & Neuro), Virtual Endoscopy, Cardiac CT (Calcium scoring, Coronary Angiography, Lesion Quantification).

UNIT-III Ultrasound Imaging: Principles of Ultrasound, Basic Ultrasound instrumentation, Image Characteristics: Ultrasonic Texture, Speckle reduction, Compensation of Phase Aberration, Tissue Characterization. Imaging techniques: (A mode, B Mode, 2B, B/M, 4B , Gated Mode, 3D, 4D, M-Mode, Echocardiography) ,Doppler Methods, Image recording devices, Image artifact, Biological effects.

UNIT-IV Magnetic Resonance Imaging:
Permanent & Super conducting magnets, Signal generation and detection, signal characteristics, signal localization, Fourier transforms in MRI, Imaging Reconstruction. Image artifacts. Coil technology, Parallel acquisition techniques, Various peripheral devices. Applications: Functional Imaging, Perfusion & Diffusion imaging (Echo planar imaging), Multi direction diffusion tensor imaging, Single & Multi Voxel Spectroscopy, MR Angiography, MRCP, Cardiac MRI (Myocardium viability, Valve function etc.,) , Flow Quantification.

UNIT-V Gamma Camera: Physics of Gamma camera, basic Instrumentation, Imaging techniques, SPECT & Whole Body studies. Applications of Gamma camera in Cardiology, Nephrology, Neurology etc.,
PET: Fundamentals of PET scanner & PET- CT, Crystal technology, Cyclotron principle, Hot Lab equipments. Applications of PET: Cardiology, Neurology & Cardiology.

TEXTBOOKS:

1. Webb's Physics of Medical Imaging, Second Edition M.A.Flower-CRC press, 2012
2. Principles of Medical Imaging by K Kirk Shung, Benjamin Tsui, Michael B Smith, Academic Press Limited, 1992.

REFRENCES:

1. Hykes, Heorick, Starchman, *Ultrasound physics and Instrumentation MOSBY year book*, 2nd Ed., 1992.
2. Stewart C.Bushong, *Magnetic Resonance Imaging- physical and biological principles*, MOSBY, 2nd Ed.,1995.
3. Zhi-Pei Laing and Paul C.Lauterbur, *Principles of Magnetic Resonance imaging –A signal processing perspective*, Metin Akay (Editor), IEEE press, New York, 2000.
4. Avinash C. Kak, Principles of Computerised Tomographic Imaging. IEEE PRESS
5. Willi A. Kalender, Computed Tomography, third edition,Wiley,2011.
6. Emerging Imaging Technologies in Medicine by Mark A. Anasvasio, CRC Press, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

FIBER OPTIC AND LASER INSTRUMENTATION

Unit -I:

Optical fibers and their properties

Introduction to Optical Fibers - principles of light propagation through a fiber – Different types of fibers and their properties –Transmission characteristics of optical fiber –Absorption losses – Scattering losses – Dispersion- advantages and disadvantages of optical fibers. Light sources for fiber optics, photo detectors, source coupling, splicing and connectors.

Unit-II:

Laser Fundamentals

Fundamental characteristics of Lasers – Three level and four level lasers – Properties of Laser and Laser modes – Resonator configuration – Q-switching and Mode locking – Cavity dumping – Types of lasers: Gas lasers, Solid lasers, Liquid lasers – Semi conductor lasers.

Unit-III:

Industrial Applications of Optical fibers and Lasers

Fiber optic sensors – Fiber optic Instrumentation system - Interferometric method of measurement of length - Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain. Fiber optic gyroscope – polarization maintaining fibers - applications. Industrial applications of lasers – Laser Doppler Velocity meter – Laser heating

Unit-IV: Holography

Holography – Basic principle; methods, Holographic Components, Holographic Interferometry and Applications, Holography for Non-destructive Testing

Opto-Electronic Components

Magneto Optic and Acoustic – optic and other types of Optical Modulators – Detectors – Application in Instrumentation

Unit-V: Medical Applications of Laser

Medical Applications Lasers - Laser and Tissue interaction, Laser instruments for surgery, Removal of tumors of vocal cords, Brain surgery, Plastic surgery, Gynecology, Oncology, Dermatology and Ophthalmology.

TEXT BOOKS:

1. Leon Goldman "The Biomedical laser technology and clinical Applications', Springer Verlag,1981
2. Industrial Applications of Lasers, John F Ready, Academic Press 1978
3. Laser Applications, MonteRoss, McGraw Hill, 1968

REFERENCES:

1. Semi Conductor Opto-electronics by Asprit Singh, McGraw Hill, 1995
2. Optical Electronics Foundation Book by Ghatak A.K. and Thiagarajar K, TMH, New Delhi, 1991
3. Optical Fiber Communications by Gerd Keiser, 4th Edition, Mc Graw Hill,2008
4. Lasers and Applications by Guimaran W.O.N & Mooradian A, Spinger Verlag.
5. Laser Electronics by Verdeyn JT, Prentice Hall.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

UNIT –I:

Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT –II:

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT -III:

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT –IV:

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit,

Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT –V:

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture
Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCE BOOKS:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

ADAPTIVE SIGNAL PROCESSING
(ELECTIVE-III)

UNIT –I:

Introduction to Adaptive Systems: Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.

UNIT –II:

Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error.

Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curves.

UNIT –III:

Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

UNIT –IV:

LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm.

Applications: Noise cancellation – Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming.

UNIT –V:

Kalman Filtering: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering.

TEXT BOOKS:

1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., 2002, PE Asia.

REFERENCE BOOKS:

1. Optimum signal processing: An introduction - Sophocles. J. Orfamadis, 2nd Ed., 1988, McGraw-Hill, New York
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, 1986, Springer –Verlag.

3. Signal analysis – Candy, Mc Graw Hill Int. Student Edition
4. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

SENSORS AND ACTUATORS
(ELECTIVE –III)

UNIT -I:

Sensors / Transducers: Principles – Classification – Parameters – Characteristics – Environmental Parameters (EP) – Characterization

Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors

UNIT –II:

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermosensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors –Thermoemf Sensors– JunctioN Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors

Magnetic sensors: Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magnetoresistive Sensing – Semiconductor Magnetoresistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros – Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

UNIT -III:

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors

Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media .

UNIT -IV:

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters –Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors –– Sensors for Manufacturing –Sensors for environmental Monitoring

UNIT -V:

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Presure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems- Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

TEXT BOOKS:

1. Sensors and Transducers by D. Patranabis, 2nd edition, PHI Learning Private Limited, 2004.

2 Mechatronics by W. Bolton, 3rd edition, Pearson Education Limited, 2005.

REFERENCE BOOKS:

1. Sensors and Actuators by D. Patranabis, 2nd Ed., PHI, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

DESIGN AND ANALYSIS OF SIGNAL CONDITIONING CIRCUITS
(ELECTIVE-III)

Unit-I: CLASSIFICATION OF INSTRUMENT TRANSDUCERS
Input characteristics, output characteristics, Electromechanical coupling characteristics-Electromechanical analogies, unified theory of bilateral electromechanical transducers, Basic two-port equations, Ideal transducers, Real transducers, generalized performance analysis of bilateral electromechanical transducers, The transducer constants: Feedback systems.

UNIT-II: SIGNAL CONDITIONING FOR RESISTIVE SENSORS: measurement of resistance, voltage dividers, Wheatstone bridge. Balance and deflection measurements, sensor bridge calibration and compensation instrumentation amplifiers, interference types and reduction

UNIT-III: SIGNAL CONDITIONING FOR REACTANCE VARIATION SENSORS: problems and alternatives, ac bridges, carrier amplifiers - application to the LVDT, variable oscillators, resolver-to-digital and digital-to-resolver converters

UNIT-IV: SIGNAL CONDITIONING FOR SELF-GENERATING SENSORS: chopper and low-drift amplifiers, offset and drifts, amplifiers- electrometer amplifiers, charge amplifiers, noise in amplifiers

UNIT-V: DIGITAL SENSORS: position encoders, variable frequency sensors - quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge-coupled sensors - types of CCD imaging sensors, ultrasonicbased sensors, fiber-optic sensors

TEXT BOOKS:
1. Instrument Transducers, An introduction to their performance and design – Hermann K P Neubert. Oxford Publishers, 2nd edition.
2. Sensors and Signal Conditioning: Ramon Pallás Areny, John G. Webster; 2nd edition, John Wiley and Sons, 2000.

REFERENCES:
1. Sensor Technology Handbook – Jon Wilson, Newne 2004.
2. Measurement System: Applications and Design – by E.O. Doeblin, McGraw Hill Publications.
3. Process Control Instrumentation Technology – D. Johnson, John Wiley and Sons
4. Sensors and Transducers – D.Patranabis, TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

BIOMEMS AND NANOTECHNOLOGY
(ELECTIVE-IV)

UNIT I MEMS AND MICROSYSTEMS

Mems and Microsystems-General principles, advantages, materials used- properties, Technology involved in MEMS. Fabrication techniques- Lithography- etching- Ion implantation- wafer bonding. Integrated processing- Bulk Micro machining- Surface micro machining- coating technology and CVD- LIGA process.

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UNIT II MICROSENSORS AND MICROACTUATORS

Microsensors and Microactuators –working principle, types- pressure sensors, thermal sensors and actuators, piezoelectric crystals-Intelligent materials and structures, Magnetic sensors and actuators- magnetic materials used for MEMS.

UNIT III MEMS AND MICROFLUIDIC SYSTEM

Principle of MOEMS- light modulator, beam splitter, digital micro mirror device, light detectors and optical switch. Micro fluidic System- Fluid actuation method, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps. Application of BioMEMS: Healthcare, drug delivery, micrototal analysis system detection and measurement methods, electronic nose, biochip.

UNIT IV INTRODUCTION TO NANOTECHNOLOGY

Essence of Nanotech, Nanofying electronics, Properties of nanomaterials, metal nano clusters, semiconductor nano particles, nano composites. Introduction to carbon nano structure, carbon molecules, carbon clusters, nanotubesapplication.

UNIT V MEDICAL APPLICATIONS OF NANOTECHNOLOGY

Nanotechnology and Biomedicine-Drug synthesis and delivery – Nanobiomedicine and diagnostic-nano fabrication methods-nanomaterials in human body- toxicity in nanomaterials.

TEXT BOOKS:

1. Tai Ram Hsu, “Mems and Microsystems, Design and Manufacture”, McGraw Hill, 2002.
2. Mohamed Gad-el-Hak, “MEMS: Introduction and Fundamentals”, CRC Press, 2005.
3. Neelina H. Malsch, “Biomedical Nanotechnology”, CRC Press, 2005

REFERENCE BOOKS:

1.Marc J Madou, “Fundamentals of Microfabrication and Nanotechnology”, CRC Press, 2011.
2. Hari Singh Nalwa, “Encylopedia of Nanoscience and Nanotechnology”, American Scientific Publishers, 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

SPEECH PROCESSING
(ELECTIVE IV)

UNIT –I:

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

UNIT –II:

Time Domain Models for Speech Processing: Introduction- Window considerations, 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 a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT –III:

Linear Predictive Coding (LPC) Analysis: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT –IV:

Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder.

Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach : spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach.

UNIT-V:

Automatic Speech & Speaker Recognition: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System

Hidden Markov Model (HMM) for Speech: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS,

Speaker Recognition: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

TEXT BOOKS:

1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., Wiley India, 2000.
3. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, Pearson Education.

REFERENCE BOOKS:

1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri, 1st Ed., PE.
2. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

REHABILITATION ENGINEERING
(ELECTIVE-IV)

UNIT I : Introduction to Rehabilitation Engineering, Principles involved in rehabilitation engineering. Steps in patient management, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability and Functional Diagnosis, Medical Rehabilitation.

UNIT II: Orthopedic Prosthetics and Orthotics in rehabilitation: Engineering Principles. Prosthesis- Amputation Types Prescribed Prostheses, Components of Upper Limb Prosthesis – Sockets and Liners, Suspension, Control Systems (Myoelectric), Shoulder, Elbow and Wrist components, Terminal Devices. Components of lower limb prosthesis – Sockets and Liners, Suspension, Hip, Pelvic, Knee and Ankle Components. Orthotics- Biomechanical Principles, Spinal, Upper Extremity and Lower Extremity. FES systems-Restoration of hand function, restoration of standing and walking,

UNIT III: Engineering concepts in sensory rehabilitation Engineering. Sensory augmentation and substitution. Assistive Technology for visually Impaired – General Purpose, Task Specific (Mobility, Reading, Writing, Computer Access, Communication). Assistive Technology for Hearing Impaired – Hearing Assistance Solutions –Medical and Surgical Approach to restore function – Hearing aids, Cochlear Implantation, Assistive Listening Solutions and Visual and Tactual Substitution.

UNIT IV: Alternative and Augmentative Communication (AAC) - user interface, Language Representation, Technology and Devices Feature. Human Factors, Performance Measurement.
Wheelchairs- Manual, Electric Power, Power Assisted, Multi Functional, Standards, Wheelchairs Transportation System, Securement Systems.

UNIT V: Rehabilitation Robotics- Intelligent Mobility Aids, Robotics Manipulation Aids, Therapeutic Robots. Environmental Control Systems. Brain Computer Interface.

TEXT BOOKS:

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1. Dr. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hosbon- An Introduction to Rehabilitation Engineering, , CRC Press Book, Taylopr and Francis Group,2007.
2. Horia- Nocholai Teodorecu, L.C.Jain , intelligent systems and technologies in rehabilitation engineering; CRC; December 2000.

REFERENCE BOOKS:

1. Charles J. Robinson “Rehabilitation Engineering”, CRC Press, 1995.
2. Joseph D.Bronzino , “The Biomedical Engineering Handbook” Volume-II, CRC Press 2006
3. G. Salvendy, “Handbook of Human Factors and Ergonomics”, Wiley, 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech (BMSP & I) **II SEMESTER**

ADVANCED MEDICAL SIGNAL & IMAGE PROCESSING LAB

LIST OF EXPERIMENTS

NOTE:

- Minimum of 10 Experiments have to be conducted.
- All Simulations are to be carried out using MATLAB/DSP PROCESSORS/LAB VIEW SOFTWARE & DSP KITS.

MEDICAL SIGNAL PROCESSING

a. Least Squares, Orthogonality, and Fourier series
b. Correlation, Fourier Spectra and the Sampling Theorem
c. Linear systems and Transfer Function
d. FIR Filter Design for Biomedical signal processing
e. IIR Filter Design for Biomedical signal processing
f. ECG noise cancellation
g. Biomedical Signal Compression

MEDICAL IMAGE PROCESSING

a. Study of Basic commands in MATLAB
b. Image Linear Filtering and Transforms
c. Image Segmentation
d. Image Restoration techniques
e. Image registration
f. Image Analysis
g. Enhancement and restoration
h. Morphological Operation