JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH IN BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION
EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Physiology for Engineers	25	75	4	0	0	4
PC-2	Medical Instrumentation	25	75	4	0	0	4
PC-3	Analytical Instrumentation	25	75	4	0	0	4
PE-1	Medical Sensors Bioinformatics and Applications Transform Techniques	25	75	**3**	0	0	3
PE-2	Bio-MEMS and Nanotechnology Robotics in Medical Applications Electronic System Design	25	75	**3**	0	0	3
OE-1	***Open Elective – I**	25	75	3	0	0	3
Laboratory I	Biomedical Instrumentation Laboratory	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Advanced Biomedical Signal Processing	25	75	4	0	0	4
PC-5	Medical Image Processing	25	75	4	0	0	4
PC-6	Sensors and Actuators	25	75	4	0	0	4
PE-3	Medical Optics Telemedicine Digital Signal Processors and Architectures	25	75	**3**	0	0	3
PE4	Physiological Control Systems Rehabilitation Engineering Adaptive Signal Processing	25	75	**3**	0	0	3
OE-2	***Open Elective – II**	25	75	3	0	0	3
Laboratory II	Advanced Medical Signal & Image Processing Laboratory	25	75	0	0	3	2
Seminar II	Seminar - II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
Total	**100**	**100**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I YEAR II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

ADVANCED BIOMEDICAL SIGNAL PROCESSING (PC- 4)

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

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

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.

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Rangaraj M. Rangayyan, Akay Metin(Editor), ”Biomedical Signal Analysis: A Case Study Approach”, Wiley Interscience, 2001.
2. Roberto Cristi, “Modern Digital Signal Processing”, 2004, Cengage Learning.
3. James V. Stone, “Independent Component Analysis: A Tutorial Introduction”, MIT Press,2004

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

MEDICAL IMAGE PROCESSING (PC- 5)

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. Nature of Biomedical images, Objectives of biomedical image analysis, Difficulties in biomedical image acquisition and analysis.

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. Biomedical applications.

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. Biomedical applications.

UNIT - V

Image Reconstruction: Image reconstruction from projections, Radon transform, Methods for generating projection data, Transmission tomography, Reflection tomography, Emission tomography, Magnetic resonance imaging, Fourier slice theorem, Back-projection theorem. Image Coding and Compression: Lossy verses lossless compression, Fundamental concepts of coding, Image coding and compression standards, Biomedical applications.

TEXT BOOKS:

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.

REFERENCE BOOKS:

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.
3. R C Gonzalez, Wintz Paul, “Digital Image Processing”, Addision Wesley, 2nd Edition, 1987.
4. A K Jain, “Fundamental of Digital Image Processing”, Prentice Hall, 2002.
5. Rangaraj M. Rangayyan, “Biomedical Image Analysis”, CRC Press, 2000.
6. Sid-Ahmed Maher A, "Image Processing Theory, Algorithms and Architecture", McGraw Hill, 1994.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I YEAR II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

SENSORS AND ACTUATORS (PC- 6)

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 – Pressure 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. D. Patranabis, “Sensors and Transducers”, 2nd Edition, PHI Learning Private Limited, 2004.
2. W. Bolton, “Mechatronics”, 3rd Edition, Pearson Education Limited, 2005.

REFERENCE BOOKS:

1. D. Patranabis, “Sensors and Actuators”, 2nd Edition, PHI, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

MEDICAL OPTICS (PE- 3)

UNIT - I

Introduction to Optical Fibers: Basic optical laws and definitions, optical fiber modes and configuration, single mode fibers, graded index fiber structure, fiber materials, attenuation, signal distortion in optical waveguides, pulse broadening in graded index waveguides.

UNIT - II

Optical Properties of Tissues: Tissue properties – refractive indices, scattering and absorption properties, light transport inside the tissue, light interactions with a strongly scattering tissue – continuous wave light, short light pulses, diffused photon density waves, Temperature rise and tissue damage – optothermal and opt acoustic effects. Fluorescence speckles.

UNIT - III

Instrumentation in Photonics: Instrumentation for absorption, scattering and emission measurement, excitation light sources – high pressure arc lamp, solid state LEDs, LASERs, optical filters, polarizer's, solid state detectors, time resolved and phase resolved detectors

UNIT - IV

Biophotonic Diagnostics: Near IR spectroscopy for biological glucose analysis, flowcytometry – basic operation, optical response – applications – optical biosensors – principles, biorecognition, optical transduction – Bioimaging – cellular, tissue imaging and in vivo imaging. Introduction to Optical Coherence Tomography

UNIT - V

Biophotonic Therapy: Photodynamic therapy – basic principle, photo sensitizers, mechanism of photodynamic action, applications – Laser tissue welding, lasers in dermatology, neurosurgery, ophthalmology, urology.

TEXT BOOKS:

1. Keiser," Optical Fiber Communication Systems", McGraw Hill Ltd., 1983
2. Ed., Tuan Volume Dinh, "Biomedical Photonics Handbook", CRC Press, 2003.
3. Leon Goldman, "The Biomedical Laser Technology and Clinical Applications", Springer Verlag, 1981.

REFERENCE BOOKS:

1. Leon Goldman and R. James Rockwell, "Lasers in Medicine", Gordan & Breach, Science Publishers Inc, 1971
2. Koebmer K R, "Lasers in Medicine", John Wiley & Sons, 1980
3. Paras N Prasad, "Introduction to Biomedical Photonics", John Wiley. 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I YEAR II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

TELEMEDICINE (PE - 3)

UNIT - I

Introduction to Telemedicine: Historical perspective and Evolution of telemedicine, Tele health, Tele care, Components of telemedicine system, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Law governing telemedicine.

UNIT - II

Telemedical Technology: Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology, Satellite communication – Mobile hand held devices and mobile communication - Internet technology, Video and audio conferencing - Clinical data –local and centralized.

UNIT – III

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

UNIT -IV

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

UNIT - V

Telemedical Applications: Telemedicine access to health care services – health education and self care. Introduction to robotics surgery, tele-surgery. Tele-cardiology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning, Usage of telemedicine.

TEXT BOOKS:

1. Norris, A.C. “Essentials of Telemedicine and Telecare”, Wiley (ISBN 0-471-53151-0), First edition, 2002.
2. O'Carroll, P.W, Yasnoff W.A., Ward E.Ripp, L.H., Martin, E.L., “Public Health Informatics and Information Systems”, Springer (ISBN 0-387-95474-0), 1st Edition, 2003.
3. Ferrer-Roca, O., Sosa-Iudicissa, M, “Handbook of Telemedicine”, IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 3rd Edition, 2002.

REFERENCE BOOKS:

1. Simpson, W. “Video over IP- A practical guide to technology and applications”, Focal Press (Elsevier). ISBN-10: 0-240-80557-7, 2006.
2. Wootton R. Craig, J., Patterson V. “Introduction to Telemedicine”, Royal Society of Medicine Press Ltd (ISBN 1853156779), 2nd Edition, 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES (PE- 3)

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.

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 - II

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, 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 - III

Architecture of ARM Processors: Introduction to the architecture, Programmer's model- operation modes and states, registers, special registers, floating point registers, Behavior of the application program status register(APSR)-Integer status flags, Q status flag, GE bits, Memory system-Memory system features, memory map, stack memory, memory protection unit (MPU), Exceptions and Interrupts-what are exceptions?, nested vectored interrupt controller(NVIC), vector table, Fault handling, System control block (SCB), Debug, Reset and reset sequence.

Technical Details of ARM Processors: General information about Cortex-M3 and cortex M4 processors-Processor type, processor architecture, instruction set, block diagram, memory system, interrupt and exception support, Features of the cortex-M3 and Cortex-M4 Processors-Performance, code density, low power, memory system, memory protection unit, interrupt handling, OS support and system level features, Cortex-M4 specific features, Ease of use, Debug support, Scalability, Compatibility.

UNIT - IV

Instruction Set: Background to the instruction set in ARM Cortex-M Processors, Comparison of the instruction set in ARM Cortex-M Processors, understanding the assembly language syntax, Use of a suffix in instructions, Unified assembly Language (UAL), Instruction set, Cortex-M4-specific instructions, Barrel shifter, Accessing special instructions and special registers in Programming.

UNIT - V

Floating Point Operations: About Floating Point Data,Cortex-M4 Floating Point Unit (FPU)-overview, FP registers overview, CPACR register, Floating point register bank, FPSCR, FPU->FPCCR, FPU-> FPCAR, FPU->FPDSCR, FPU->MVFR0, FPU->MVFR1.

TEXTBOOKS:

1. Avtar Singh and S. Srinivasan, "Digital Signal Processing", CENGAGE Learning, 2004.
2. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Elsevier Publications, 3rd Edition.

REFERENCES:

1. ARM System Developer's Guide Designing and Optimizing System Software by Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier Publications, 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

PHYSIOLOGICAL CONTROL SYSTEMS (PE - 4)

UNIT - I

Physiological Systems with feedback: Modeling of physiological systems, model based noise reduction and feature extraction, Physiological control systems analysis. Differences between engineering and physiological control systems, Mathematical modeling, linear models of physiological systems, distributed parameter and lumped parameter models

UNIT - II

Static Analysis of Physiological Systems: Determination of steady state operating point, Steady state, analysis, Regulation of cardiac output, Chemical regulation of ventilation. Time domain analysis of linear control systems. Transient response analysis- dynamics of neuromuscular reflex motion, Frequency domain analysis of linear control systems, frequency response of circulatory control and glucose insulin regulation.

UNIT - III

Relative Stability: Stability analysis of pupilary light reflex, model of Cheyne-Stokes breathing, Identification of physiological control systems, parametric estimation, identification of closed loop, system, optimization of physiological control, single parametric optimization, constrained optimization, and adaptive control of physiological variables.

UNIT - IV

Modeling the Nerve Action Potential: Voltage clamp experiment and its interpretation, model for the strength duration curve, modeling skeletal muscle contraction, cross bridge theory of muscle contraction, linear model of muscle contraction, applications of skeletal muscle contraction, modeling myoelectric activity

UNIT - V

System Identification in Physiology: Modeling of sensory receptors and pupil control system. Modeling cardiovascular system, Modeling blood flow, systemic blood flow and coronary circulation. Behavior of the immune system, linearized model of immune response to disease.

TEXT BOOKS:

1. Michael C.K. Khoo, “Physiological Control Systems-Analysis Simulation and Estimation”, IEEE Press Series in Biomedical Engineering, 2000.
2. Suresh R. Devasahayam, “Signals and Systems in Biomedical Engineering-Signal Processing and Physiological Systems Modeling”, Kluwer Academic/Plenum Publishers, 2000.

REFERENCE BOOKS:

1. Milsum John H. Biological, “Control System Analysis”, Mc Graw Hill, 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

REHABILITATION ENGINEERING (PE - 4)

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:

1. Dr. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hosbon,"An Introduction to Rehabilitation Engineering", CRC Press Book, Taylor 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. I Year II SEMESTER BIOMEDICAL SIGNAL PROCESSING AND INSTRUMENTATION

ADAPTIVE SIGNAL PROCESSING (PE- 4)

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 Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

UNIT – III

Steepest Descent Algorithms: Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curves 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:** Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform. Introduction to MUSIC

UNIT – V

State Estimators: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Kaluri V. Rangarao, Ranjan K. Mallik, "Digital Signal Processing: A Practitioner's Approach", ISBN: 978- 0-470-01769-2, 210 pages, November 2006, John Wiley (UK)
2. Sophocles. J. Orfamadis, "Optimum signal processing: An introduction", 2nd Edition, 1988, McGraw-Hill, New York
3. S. Thomas Alexander, "Adaptive signal processing-Theory, and Applications, 1986, Springer –Verlag.
4. Candy, "Signal analysis", McGraw Hill Int. Student Edition
5. James V. Candy, "Signal Processing: A Modern Approach", McGraw-Hill, International Edition, 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Semester Biomedical Signal Processing and Instrumentation

ADVANCED MEDICAL SIGNAL & IMAGE PROCESSING LABORATORY

Note:

- Minimum of 10 Experiments to be conducted.
- All Simulations are to be carried out using MATLAB/DSP PROCESSORS/LAB VIEW SOFTWARE (Or any equivalent software) & DSP KITS.

Medical Signal Processing:

1. Least Squares, Orthogonality, and Fourier series
2. Correlation, Fourier Spectra and the Sampling Theorem
3. Linear systems and Transfer Function
4. FIR Filter Design for Biomedical signal processing
5. IIR Filter Design for Biomedical signal processing
6. ECG noise cancellation
7. Biomedical Signal Compression
8. Detection of QRS complex and heart rate measurement.

Medical Image Processing:

1. Study of Basic commands in MATLAB
2. Image Linear Filtering and Transforms
3. Image Segmentation
4. Image Restoration techniques
5. Image registration
6. Image Analysis
7. Enhancement and restoration
8. Morphological Operation