COURSE CONTENTS

Category	Title	Code	Credits-6C			Theory Papers
			L	T	P	
Departmental Core -18	Biomedical Signal Processing	BM 701				Max.Marks-100
			3	1	2	Min.Marks-35 Duration-3hrs.

Unit I Introduction: Origin of Bioelectric signal sand their characteristics. Noise coupling, power line and other interfacing sources. Artifacts. Analysis of concurrent couple and correlated processes.

Unit II Various amplifier configuration. Signal Conversion, Digitations method and fundamentals of Digital Signal processing.

Unit III Filtering technique for removal of noise, artifacts and interferences. Time domain and frequency domain filtering. Notch & frequency domain filtering. Notch & Comb filters & their design. Optimal and Adaptive filtering technique.

Unit IV Detection of events in bioelectric signals like ECG, EEG, PCG etc. Detection of waves, correlation & coherence analysis, Few case studies.

Unit V Wave shaping, envelope extraction and analysis . Processing of events related potentials. DSP techniques for Biomedical Signal. Pattern detection and classification.

Unit VI SNR consideration. SNR improvement method. Protection circuit for electrical safety. EMI/EMC regulation
Case Studies.

Reference Books:

1. Biomedical Signal Analysis- A case study approach, Rangaraj M. Rangayyan, EMB, WSE, Wiley.
2. Biomedical Digital Signal Processing, Wills J. Tompkins, PHI
3. Medical Instrumentation: Application & Design, Webster JG, 3e, wiley NKY.
4. Signals & System Analysis in Biomedical Engineering, Robert B. Northrop, CRC Press.
5. Microelectronics Circuit, Sedra Smith, Oxford Press

List of Experiments:-

1. Design Henning moving average filter. Plot the magnitude and phase response of this filter, Also filter the ECG signal in the file ecg_hfn.dat using this filter and plot the filtered and raw ECG.
2. Design 8-point moving average filter Plot the magnitude and phase response of this filter. Filter the ECG signal in the file ecg_hfn.dat using this filter and plot the filtered and raw erg.
3. The ECG signal in the file ecg_lfn.dat has a wondering base line. Filter the signal with the first order difference operator and plot the magnitude response of filter, filtered and raw ECG.
4. The ECG signal in the file ecg_lfn.dat has a wondering base line. Filter the signal with the ,their point central difference operator and plot the magnitude response of filter, filtered and raw ECG.
5. The data file ecg2x60.dat contains an ECG signal. Sampled at 200Hz, with a significant amount of 60HZz power line artifact.Desing a notch filter to remove the artifact and implement it in MATLAB.Plot the frequency response of the filter. Also plot the filtered and raw ECG
6. Filter the noisy ECG signal in the file ecg_hfn.dat using Butterworth low pass filter realized through MATLAB with the following characteristics: order 2, cut off frequency 10Hz plot the magnitude response of the filter, filtered ECG and raw ECG.
7. Filter the noisy ECG signal in the file ecg_hfn.dat using Butterworth low pass filter realized through MATLAB with the following characteristics: order 8, cut off frequency 20Hz plot the magnitude response of the filter, filtered ECG and raw ECG.

8. Filter the noisy ECG signal in the file ecg_hfn.dat using Butterworth low pass filter realized through MATLAB with the following characteristics: order 8, cut off frequency 40Hz plot the magnitude response of the filter, filtered ECG and raw ECG.
9. Filter the noisy ECG signal in the file ecg_hfn.dat using Butterworth high pass filter realized through MATLAB with the following characteristics: order 8, cut off frequency 1Hz plot the magnitude response of the filter, filtered ECG and raw ECG.
10. Filter the noisy ECG signal in the file ecg_hfn.dat using Butterworth high pass filter realized through MATLAB with the following characteristics: order 8, cut off frequency 2Hz plot the magnitude response of the filter, filtered ECG and raw ECG.

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
Departmental Core -19	Medical Imaging System	BM 702	L	T	P	Max.Marks-100
			3	1	0	Min.Marks-35 Duration-3hrs.

Unit I X- ray Machine and Digital Radiography: Basis of Diagnostic Radiology, Nature of X- ray, Production of X-rays, X-ray Machine, visualization of X-rays, Dental X-ray Machines, Portable and mobile X-ray units, Physical Parameters for X-ray Detectors, Digital Radiography,
X-ray Computed Tomography: Computed Tomography, System Components, Gantry Geometry, Patient Dose, in CT Scanner

Unit II Magnetic Resonance Imaging System: Principle of NMR Imaging System, Image Reconstruction Techniques, Basic NMR, Functional MRI (FMRI) Components, Biological effects of NMR Imaging, Advantages of NMR Imaging System.

Unit III Ultrasonic Imaging System: Diagnostic Ultrasound, Physics of ultrasonic waves, Medical ultra sound, Basic pulse – echo apparatus, A- scan, Echocardiograph, B-scanner, real tine ultrasonic Imaging System, Multi- element linear array scanners, Digital Scan converter, Biological Effects of ultrasound.

Unit IV Thermal Imaging System. Medical Thermography, Physics of thermography, Infrared Detectors, Thermo graphics Equipments, Quantative medical thermography, pyroelectric vidicon Camera, Thermal Camera based on IR Sensor with digital focal plane array.

Unit V Nuclear Medical Imaging System: Radio Isotopes in medical diagnosis, Physics of radioactivity, radiation detectors, pulse height analyzer, uptake monitoring equipment, radio isotopes rectilinear scanner, the gamma Camera, Multi Crystal Gamma Camera Emission Computed Tomography (ECT), Single Photon emission Computed Tomography (SPECT), Positron Emission Tomography (PET Scanner).

Reference Book:
1 Introduction to Biomedical Imaging, By: Andrew Webb.
2. Medical Imaging System. By Maco vski, Albert Printsol
3. Hand Book of Biomedical Instrumentation " R.S Khandpur, TMH
4. Essentials physics of medical Imaging By, Jerold T. Bushburg
5. Physics of diagnostics radiology. By, Christensen
6. Biomedical Electronic and Instrumentation by S K Venkataram, Galgotiya pub.
7. Medical instrumentation by S. Ananthi , New Age Pub.

COURSE CONTENTS

Category	Title	Code	Credits-6C			Theory Papers
Departmental Core -20	Data Communication	BM 703	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35 Duration-3hrs.

Unit I Basic data communication concepts: Host computers and terminal modems, parallel and serial transmission Asynchronous and Synchronous transmission. Simplex, half duplex and duplex. Front end processor, Port-sharing device, Line splitters and remote intelligent controllers. Multiplexer: TDM, FDM, VVDM. Data compression devices, Inverse multiplexer.

Unit II Data Interfaces and transmission :Digital interface standards ; RS-232C standard, hand shaking, connecting a DTE in RS-232 C, RS-449, RS-422A and RS-423A standards. High speed desktop serial interfaces. Remote digital transmission : T carrier ISDN, Packet data networks, Digital access. Data Communication Efficiency : Modems, AM, FM, Phase modulation, multi speed modems, high speed modems, Error Correcting modems Data compression in modems. Short-wave modems, Facsimile and Fax modems.

Unit III Data Integrity and, Security: Data Integrity, Sources of error control approaches. Implementation of error Control, Echo checking parity checking and cyclical purity, Hammering code, Checksums, Cyclical Redundancy check. Security and security measuring.

Unit IV Architectures and Protocols: OSI model, Traditional communications architectures: Systems network architecture and other communication architecture Protocols: Polling and selecting, automatic repeat request common link level protocols. Binary synchronous communications characters in a BSC frame, Synchronous data link control. Protocols Converters and Code Converters TCP/IP protocols.

Unit V Data transport Network: Packet switching, LAN and Indent working.

Reference Books:
1. Computer network " Tenenbum"
2. Digital Communication "Frozen "
3. Digital Communication & Computer Networking "William Sterlling"

List of Experiments:
1. Study of sampling theorem & verification of types of sampling.
2. PAM modulation & demodulation.
3. PPM modulation & demodulation
4. PWM modulation & demodulation
5. TDM modulation & demodulation

COURSE CONTENTS

Category	Title	Code	Credits-6C			Theory Papers
			L	T	P	
Departmental Core- 21	Biomedical System Modeling & Simulation	BM 704	3	1	2	Max.Marks-100 Min.Marks-35 Duration-3hrs.

Unit I Mathematical Modeling: Generalized System Properties, Models with Combination of system Elements, Linear models of physiological System, Distributed parameters verses lumped-parameter Models. Linear System and the Superposition principles. Laplace Transforms and Transfer Function. The Impulse Response and linear Convolution.

Unit II Static Analysis of Physiological System Introduction, Open -loop Versus Closed loop system, Determination of the steady- State operating Points, Steady state analysis, Regulation of cardiac output, Regulation of Glucose, Chemical regulation of ventilation.

Unit III Linear red Respiratory Mechanics: Open – Loop Versus Closed Loop, Open loop and closed loop transient response, Description of Impulse and Sep response, open loop Versus Closed –loop Dynamic :Other Consideration

Unit IV Frequency – Domain response to Sinusoidal Inputs, Graphical Relationship of frequency Response, Frequency response of a model of Circulatory Control, Frequency response of Glucose –Insulin Regulation.

Unit V Stability and Transient response, root locus plot, Routh –Hurwitz Stability Criterion, Nyquist Criterion for stability, Relative Stability, Stability Analysis of the papillary light Reflex, Model of Cheyne – Stroke Breathing. Case Study: Minimal Model of Blood Glucose Regulation, Closed – loop Identification of the respiratory Control System

Reference Books:

1. Physiological Control System By Micheal C. K. Khoo. PHI
2. Blesser, W.B. A System approach to Biomedicine. McGraw-Hill.
3. Milsum, J.H. Biological Control System Analysis. McGraw-Hill.

List of Experiments (Using MATLAB simulink):

1. Simulation of Linear Respiratory system model and study dependency of dynamics of airflow, volume etc on breathing rate.
2. Simulation of cardio-vascular system model and study variation of cardiac output volume on change in heart beat rate, pleural pressure, venous return etc.
3. Simulation of cardio-vascular system model and study variation of venous return output on change in heart beat rate, stroke volume etc.
4. Simulation of cardio-vascular system model and study of response under different physiological conditions like exercise, myocardial infarction etc .
5. Simulation of Blood Glucose regulatory system model and study of the variation of blood glucose level under normal, Type-I and Type -II diabetes conditions.
6. Simulation of Blood oxygen regulatory system (Ventilation) model and study of the variation of blood oxygen and carbon di-oxide levels under normal and high altitude breathing.
7. to simulate skeletal muscle reflex model behavior.
8. To simulate Lung mechanics model and analyze time domain response under impulse input. Consider the model as of Zero, first and second order.
9. To simulate Lung mechanics model and analyze time domain response under step input. Consider the model as of Zero, first and second order.
10. To simulate iris reflex model under varying light conditions and its stability analysis.

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
			L	T	P	
Departmental Electives DCO(E)-I	Laser and fiber optics in Medicine	BM 705 Elective-I (i)	3	1	0	Max.Marks-100 Min.Marks-35 Duration-3hrs.

Unit –I Properties of light like Emittance and absorptanc, absorption, Scattering, reflection, polarization, Refraction and interference, Snell's Law, Numerical Aperture, Fresnel reflection. Optical fiber and its properties, types of operation.
Fiber profile: Dispersion, data rate, Data rate and Band width, Attenuation, losses.

Unit –II Connectors, Splices and couplers: Introduction, Splices: Mechanical, Fusion, protection of splice, Connectors: SMA, STC, Bionic etc, coupling – passive, Stan, TEE types.
Optical Source and photo Detector: Introduction: Creation of photons, LED, the injection Laser Diode (ILD) Characteristics of LED and ILD, Photo Detector- Introduction, PIN Diode, Avalanche photo diode, photo diode parameters, Detector noise , Speed of response , SNR.

Unit – III Introduction to laser: Laser physics: Introduction, principle components of laser system, laser emission: sequence of events, Characteristics of laser light and basic terminology , mode of emission.
Laser Systems: Introduction, types of laser- Solid state lasers, Gas lasers and Dye lasers, lasers used in medical practice-Ruby laser, CO_2 laser, Nd: YAG Laser and related Solid state laser.

Unit –IV Laser – Tissue Interaction: Introduction: the eye , skin and the other tissue, terminology: Spectral band designation, Energy and power, irradiation and radiant exposure, fluence, Thermal Diffusion fibers and contact tips,. Types of laser- Tissye interaction Photo coagulation, photo thermal ablation, photo disruption, photo chemical Interaction

Unit-V Introduction, General Surgery, Dermatology, ophthalmology, Cardiovascular & Chest Surgery, Gynecologic laser, Neuro Surgery, Tumor Surgery, urology, otolaryngology & neck head Surgery.

Reference Books:

1. Theraupeutic laser: Theory and practice by G. David Baxter, Churchill livingstone publication.
2. Medical Laser and their Safe use by David H. Shiney, Stephen and L.Trokel, Springer-Verlag publication.
3. Elements of fiber optics by S. L.Wymer, Regents- prentice Hall publication.
4. Laser and optical fibers in medicine by katzer and Abraham, Academic press publication.
5. An Introduction to optical fiber by A.M.Cherin, Mc Grqw Hill publication.

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
Departmental Electives DCO(E)-I	VLSI Design	BM 705 Elective-I (ii)	L	T	P	Max.Marks-100
			3	1	0	Min.Marks-35 Duration-3hrs.

Unit I Introduction to CMOS circuit, Circuit & System representation Behavioral representation, structural representation. Physical representation MOS transistor theory. NMOS and PMOS enhancement transistor. Threshold voltage, body effect. MOS device design equation. Basic DC equation, second order effects, MOS models.

Unit II The complementary CMOS inverter-DC character, Static load MOS inverters. The differential inverter. Tri-state inverter. Bipolar devices, diodes, transistors, BICMOS inverters.

Unit III Review of silicon semiconductor technology and basic CMOS technology-n-well and p-well process. Interconnect and circuit Twin-tub process layout design rules and latch-up, latch-up triggering and prevention.

Unit IV Circuit characterization and performance estimation resistance and capacitance estimation, Switching characteristics, CMOS gate transistor sizing, power dissipation. Basic physical design of simple logic gates. CMOS logic structure.

Unit V CMOS design methods. Design strategies. Programmable logic, programmable logic structure, reprogrammable gate arrays. Exiling programmable gate array. Algotonix, concurrent logic, sea of gate and gate array design VHDL as a tool.

References books:

1. Neil, H.E. Wasdte, Kamran Eshraghian, Principles of CMOS VLSI design, Pearson Education.
2. Wyne Wolf, Modern VLSI Design-system on silicon, PHI.
3. Phillip E. Allen and Douglas R holding, CMOS Analog Circuit Design, 2nd edition, Oxford University press.

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
			L	T	P	
Departmental Electives DCO(E)-I	Biomechanics	BM 705 Elective-I (iii)	3	1	0	Max.Marks-100 Min.Marks-35 Duration-3hrs.

UNIT I. Principles of mechanics, viscoelasticity, anisotropy applied to biomaterials. Mechanics of soft and hard tissues. Introduction to two dimensional statics, kinematics and dynamics as applied to muscoskeletal systems. Electromechanical properties of bones, teeth and connective tissues.. Implant tissue biomechanics and crack propagation in bones

UNIT II. Monitoring Devices: Catheter Mathematical Model, response to a sinusoidal input. Tonometry- different types. Human locomotion - Monitoring & Recording of body movements.- Foot Pressure measurements, Force platform , Pedobarograph, Respiratory Sound measurement.

UNIT III. Prosthetic Devices: Artificial heart valves- development- different types & testing, Heterografts, Homografts, Development of arterial grafts. Total Hip Prosthesis- Stress analysis & instrumentation , Knee Prosthesis. Muscle mechanics. Neural control movement. Limb prosthesis design and control. Cardiovascular mechanics and respiratory mechanics.

UNIT IV. Orthotic Devices: Scoliosis Measurement and correction procedure, Biomechanics of it's treatment. Exoskeletal system for paraplegics - Powered wheel chairs – crutches & canes.

UNIT V. Prosthetic devices. Orthopedic orthotic devices. Orthopedic shoes and shoes alternatives, Crutches, canes & wheel chairs

Reference :-

1) Alexander R Mc Neill , “Biomechanics”, Chapman and Hall, 1975

2) D N Ghista , “Biomechanics of Medical Devices” , Macel Dekker , 1982

3) A Z Tohen and C T Thomas , “Manual of Mechanical Orthopaedics”

4) D N Ghista and Roaf , “Orthopaedic Mechanics”, Academic Press

5) DJ Schneck and JD Bronzino, Biomechanics: Principles and applications; CRC press

6) Aydin Tozeren, Human Body Dynamics: Classical Mechanics and Human Movement, Springer

7) Duane Knudson " Fundamentals of Biomechanics, springer

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
			L	T	P	
Departmental Elective DCO(E)-I	Bioinformatics	BM 705 Elective-I (iv)	3	1	0	Max.Marks-100 Min.Marks-35 Duration-3hrs.

Unit I Introduction to Bio-informatics: Objectives of Bio-informatics; Data integration; Data Analysis; Bio-informatics databases and tools; Molecular approach versus Bio Informatics approach; Overview of Bio-informatics application.

Unit II Molecular biology and Information: Basic chemistry of nucleic acids; Structure of DNA; Genes-The functional elements in DNA; DNA sequencing and Polymeric chain reaction; Cloning methodology; Amino acids; Protein structure; Protein folding function.

Unit III Linux system and Programming with Perl: The basics of Linux system; Text processing; Writing Shell programs; Introduction to Pen; Programming with Perl; Perl applications for Bio-informatics; BioPerl. Sequence Alignment: Introduction to Sequence Analysis; Models for sequence analysis and their Biological motivation; Methods of alignment; usage of gap penalties and Scoring matrices; Tools for sequence alignment; Tools for multiple sequence alignment; Applications of Multiple alignment.

Unit IV Gene Mapping and Gene expression: Applications of Gene mapping; DNA sequencing; DNA micro arrays; Algorithms for gene alignment; Gene prediction tools; Tools for DNAIRNA structure and function analysis.

Unit V Proteomics: Protein structure visualization; Protein structure prediction; Methods of Protein structure for known folds; Methods of protein structure for unknown folds; Methods for structure prediction; Protein analysis; Tools for protein analysis.

Reference books:

1. Bio-informatics. Concepts, Skills and Applications. By: S.C. T. Rastogi, Namita Parag Rastogi. CBS Publication.
2. Bio-informatics: A practical guide to the Analysis of Genes and Proteins. By: Baxevanis A.D., Francis Ouellette. Wiley Interscience, New York.
3. Introduction to bioinformatics, Attwood, PHI
4. Bio-informatics Sequence and Genome Analysis. By: Mount David. Cold Spring Harbor Laboratory Press.
5. Bio-informatics Basics Applications in Biological Science and Medicine. By: Rashidi, Hooman and Lukas K. Buehler. CRC Press.
6. Beginning Perl for Bio-informaties. By: James Tinsdall. O'Reilly publication.