RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VII-Semester

BM-701 Biomechanics

Unit. 1 Bone structure and composition mechanical properties of bone viscoelastic properties-Maxwell and Voight models- anisotropy- Electrical properties of bone-fracture mechanism and crack propagation I in bones- fractures fixators- repairing of bones- mechanical properties of collagen rich tissues, teeth.

Unit. 2 Structure and function of cartilages, tendons, ligaments- biomechanics of joints, Human locomotion- gait analysis- foot pressure measurements- Pedobarograph- force platform- mechanics of foot- mechanics of plantar ulcers arthritis- biomechanical treatment

Unit. 3 Artificial heart valves- biological mechanical valves developments- Heterograft, Homograft- testing of valves. Total Hip Prosthesis requirements- different types of components- stress analysis and instrumentation, knee prosthesis.

Unit. 4 Biomechanics of spines- Scoliosis- measurements- biomechanical treatment- instrumentation-Muscle mechanics- Exoskeletal system for paraplegics- powered wheel chairs-crutches and canes.

Unit. 5 Monitoring devices. Catheter mathematical model, responses to a sinusoidal input. Tonometry different types Respiratory sound measurements.

References:

1. Biomechanics by Alexander R Mc Neil , Chapman and Hall, 1975
2. Biomechanics of Medical Devices by D. N. Ghista ,Macel Dekker, 1982
3. Manual of Mechanical Orthopedics by A. Z. Tohen and C. T. Thomas .
4. Orthopedic Mechanics by D. N. Ghista and Roaf, Academic Press.
5. Basic Orthopedics Biomechanics by V. C. Mow and W. C. Hayes ,Lippincott- raven publication

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New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VII-Semester

Departmental Elective BM702 (A) Peripherals And Interfacing

Unit. 1 Introduction to Embedded Systems: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.

Unit. 2 Embedded System Architecture: Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.

Unit. 3 Input Output and Peripheral Devices Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock. Introduction to communication protocols: basic terminologies, concepts, serial protocol: I2C, CAN, fire wire, USB. Parallel protocols: PCI bus, IrDA, Bluetooth, IEEE 802.11, wireless protocols.

Unit. 4 Memory System Architecture Caches, virtual memory, MMU, address translation, memory and interfacing, memory write ability and storage performance. Memory types, composing memory – advance RAM interfacing, microprocessor interfacing I/O addressing, interrupts, direct memory access, arbitration multilevel bus architecture.

Unit. 5 Embedded System Supporting Technologies Difference between normal OS and RTOS, scheduling algorithms. Case study: Tiny OS, VxWorks, QNX. Overview of VLSI technology, introduction to device drivers. Case studies: washing machine, air-conditioning, auto focus camera.

TEXT BOOKS F Vahid, T Gijarvis, Embedded systems: A unified hardware/software approach, Wiley, 1999. 4. Raj Kamal, Embedded Systems Introduction, 2nd Ed., TMH publication, 2015.

REFERENCES 1. David E Simons, An Embedded Software Primer, Pearson, 1999.

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New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VII-Semester

Departmental Elective BM702 (B) Biostatistics

Unit. 1 Data Collection and Sampling Methods Concepts of population and sample and need for sampling methods of collecting data. Types of sampling- simple random sampling with and without replacement, errors in sampling and data acquisition. Statistical tests of hypotheses, box plots of a data sample, distribution & scatter plots.

Unit. 2 Random Variables Discrete and continuous variables, probability mass function, probability density function and cumulative distribution function, jointly distributed random variables: marginal and conditional distributions, independence of random variables. Expectation of a random variable and its properties, expectation of sum of random variables, product of independent random variables, conditional expectation and related problems, moments, moment generating function & their properties, random vectors and central limit theorem.

Unit. 3 Distributions of Function of Random Variables Distribution of sum, product and quotient of two variables, reproductive property of standard distributions, $\chi 2$ (chi-square), t and F distributions (central cases only) and their limiting forms, bivariate normal distribution and its properties, tests of goodness of fit, tests of independence.

Unit. 4 Statistical Filtering Process Adaptive filtering: principle and application, steepest descent algorithm convergence characteristics, LMS algorithm, convergence, excess mean square error, application of adaptive filters, RLS algorithm, derivation, matrix inversion, initialization. Finite time estimation of mean value, correlation, synchronous averaging, regression, multiple and partial correlation, one-way and two-way analysis of variance (ANOVA).

Unit. 5 Case Studies For Biomedical Application Processing of biomedical signals like ECG, EMG, EEG etc., removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG, cancellation of ECG from EMG signal. Introduction to principal component analysis (PCA), Covariance matrix, residuals from PCA, PCA estimations from raw data matrix. S.G.S.I.T.S./SYLLABUS/2018-19

TEXT BOOKS 1. Krzanowski, W.J., Principles of Multivariate Analysis, Oxford Univ. Press, 1988. 2. Statistics Tool Box with MATLAB.

REFERENCES 1. Rangaraj M Rangayyan, Biomedical Signal Analysis case study approach, PHI, 2004.

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Biomedical Engineering, VII-Semester

Departmental Elective BM702 (C) Reliability Engineering

Unit. 1 Introduction to reliability and indices. Review of probability theory. Density and distribution function of continuous and discrete random variable.

Unit. 2 Component reliability, hazard function, failure laws, exponential failure law, wear in period and its importance. Safety and reliability, replacement, methods of reliability improvement.

Unit. 3 Reliability evaluation of series, parallel, and series–parallel network. Complex network reliability evaluation using event, space, decomposition, tie-set, cut-set and MonteCarlo simulation technique, convergence in Monte Carlo simulation. Stand by system and load sharing system,multi-state models.

Unit. 4 Markov process, State diagram, Availability and unavailability function. Evaluation of time dependent and limiting state probabilities. MTTF calculation. Concept of frequency and durations. State enumeration method for evaluating failure frequency, MUT, MDT,frequency balance approach.

Unit. 5 Reliability testing, estimation of reliability function, failure function and MTTF from grouped and ungrouped data's, censoring and accelerations,parametric methods.

Text books

1 Introduction to reliability engineering –E.E.Lewis, John Wiley and Sons, 1987
2 Reliability and maintainability engineering, C.E. Ebeling, TMH, 2006

Reference books

1 Reliability Engineering : Probability Models and maintenance methods –Joel A.Nachlas,Taylor and Francis 2005
2 Reliability evaluation of engineering system: concept and techniques-R. Billinton, R.N.Allon, Pitman, 1984

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Biomedical Engineering, VII-Semester

Open Elective BM703 (A) Total Quality Management & Safety Measures

Unit. 1 Fundamentals of Quality Management Definition of Quality, Dimensions of Quality, and Quality Planning - Quality costs. - Analysis Techniques of quality Cost - Basic concepts of Total Quality Management, Historical Review. - Principles of TQM, Leadership – Concepts, Role of Senior Management - Quality Council, Quality Statements – Strategic Planning - Deming Philosophy - Barriers to TQM Implementation

Unit. 2 Quality Management Principles Customer satisfaction – Customer Perception of Quality - Customer Complaints, Service Quality, Customer Retention - Employee Involvement – Motivation, Empowerment - Teams and Team Work - Recognition and Reward, Performance Appraisal, Benefits - Continuous Process Improvement – Juran Trilogy – PDSA Cycle, 5S, Kaizen - Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development - Performance Measures – Basic Concepts, Strategy, Performance Measure Benchmarking – Reasons to Benchmark - Benchmarking Process – Quality Function Deployment (QFD) – House of Quality - QFD Process - Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) – Concept, Improvement Needs - FMEA – Stages of FMEA

Unit. 3 Statistical Process Control Seven Tools of Quality: I, II, and III - Concept of Six Sigma: I and II - New Seven Management tools: I and II - Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample - Normal Curve, Control Charts for variables and attributes, Process capability

Unit. 4 Regulatory Organizations In Medicine Need for ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System – Elements, Implementation of Quality System - Quality Auditing - Need for Accreditation of hospitals - FDA Regulations- Joint Commission – Regulatory Bodies of India-Medical Council of India - Pharmacy Council Of India, Indian Nursing Council - Dental Council of India, Homeopathy Central Council

Unit. 5 Safety Measurements Designing to reduce radiation hazards- Radio frequency radiation safety management, Guidelines for radiation protection- Molecular medicine and radiation safety program-procedures for safe operation of radiation equipment ,Hazard and risk in radiation protection- radiological incidents and emergencies- Regulation to radiation protection. Hazards associated with UV radiation- UV control measures - Safety management of UV

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Biomedical Engineering, VII-Semester

Open Elective BM703 (B) Biomedical Signal Processing

Unit. 1 Introduction to Signal Processing Signals and systems, signal processing, concept of frequency in continuous time and discrete time signals, analog to digital and digital to analog conversion, sampling and reconstruction of signals.

Unit. 2 Frequency Domain Analysis of Signals and Systems Analysis of linear time invariant systems in the z-Domain, analysis and characterization of LTI systems using the Laplace transform, correlation functions and spectra at the output of LTI systems, linear time-invariant systems as Frequency-Selective filter, inverse systems and deconvolution, linear filtering methods based on the DFT, frequency analysis of signals using the DFT, discrete cosine transform.

Unit. 3 Efficient Computation of the DFT: Fast Fourier Transform Algorithms Fast Fourier transform, decimation in time FFT algorithms, decimation in frequency FFT algorithms, FFT algorithms for N composite number- Spectrum analysis of bio signals. Quantization effects in the computation of the DFT. Case study: frequency analysis of ECG signals.

Unit. 4 Design of FIR Digital Filer FIR digital filters realizations, direct, cascade, lattice forms, FIR filter design using Fourier series, use of window functions like rectangular, raised cosine, kaiser.

Unit. 5 Design of IIR Digital Filer IIR digital filters realizations, direct, cascade, parallel forms, analog filter approximations, and Butterworth and Chebyshev approximations, frequency transformation techniques. Case study: PCA and ICA for biomedical signal.

TEXT BOOKS 1. Oppenheim & R W Schafer, Digital Signal Processing, Prentice Hall, 2008. 2. R Rabiner& B. Gold, Theory & Application of Digital Signal Processing, Prentice Hall (India), 1975.

REFERENCES 1. Andreas Antonion, Digital Filters Analysis & Design, Prentice Hall (India), 2007.

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Biomedical Engineering, VII-Semester

Open Elective BM703 (C) Medical Imaging Techniques

Unit. 1 Ultra Sound In Medicine - Introduction, production of ultra-Sonics - properties - principles of image formation, capture and display - principles of A-mode , B-mode and M-mode display - principles of scan conversion -Doppler Ultra sound and Color flow mapping - Application of diagnostic ultra sound.

Unit. 2 X-Ray computed tomography - Principles of sectional imaging - scanner configuration - data acquisition system - image formation principles - conversion of x-ray data in to scan image - 2D image reconstruction techniques - Iteration and Fourier methods.

Unit. 3 Magnetic Resonance Imaging - Principles of MRI – pulse sequence- image acquisition and reconstruction techniques – MRI instrumentation – magnets – gradient system – RF coils- receiver system – Functional MRI -Application of MRI.

Unit. 4 Radio isotope imaging - Rectilinear scanners,linear scanners - SPECT - PET - Gamma Camera - Radionuclide for imaging, Emission Computed Tomography.

Unit. 5 Infra-red Imaging - Physics of thermography - Imaging systems - Pyro electric vidicon camera – clinical thermography - liquid crystal thermography.

References:

1. The Physics of Medical Imaging by S. Webb, Adam Highler, Bristol
2. Principle of Computed Tomography by A. C. Kak , IEEE Press New York
3. Medical Image Formation Perception and Measurement by G. A. Hay. John Wiley & Sons Ltd (March 9, 1977)

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Biomedical Engineering, VII-Semester

BM- 704 ARTIFICIAL NEURAL NETWORKS

Departmental Laboratory

Practicals based on experimental setups or coding/simulation mode on the following topics:

1. Parallel and distributed processing - I: Interactive activation and competition models
2. Parallel and distributed processing - II: Constraint satisfaction neural network models
3. Perceptron learning
4. Multilayer feed forward neural networks
5. Hopfield model for pattern storage task
6. Hopfield model with stochastic update
7. Competitive learning neural networks for pattern clustering
8. Solution to travelling salesman problem using self organizing maps
9. Solution to optimization problems using Hopfield models
10. Weighted matching problem: Deterministic, stochastic and mean-field annealing of an Hopfield model

Note: Few experiments can be performed through virtual labs.

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Biomedical Engineering, VII-Semester

BM- 705 TEST & CALIBRATION

Open Elective Laboratory

Practicals based on experimental setups or coding/simulation mode on the following topics:

1. Calibration of ammeters & voltmeters
2. Calibration of capacitive transducer for angular displacement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Study of resistance temperature detector for temperature measurement.
5. Calibration of thermistor for temperature measurement.
6. Calibration of thermocouple for temperature measurement.
7. Calibration of hot wire anemometer for temperature measurement.
8. Calibration of Pressure Gauges
9. Calibration of strain gauge for temperature measurement.
10. Study and calibration of photo and magnetic speed pickups for the measurement of speed
11. Study and calibration of a rota meter for flow measurement.
12. Calibration curve & fitting method

Note: Few experiments can be performed through virtual labs.