RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VI-Semester

BM601- Control Systems

Unit. 1 Modeling of Dynamic Systems and Simulation
Integro-differential equation of linear systems such as mechanical, hydraulic, pneumatic and electrical systems. Block diagram and Signal flows graph method of representing the dynamic equations, analogue simulation, linearity, impulse response and concept of transfer function, Mason's gain formula, control system components: errors detectors ac and dc servomotors, servo amplifier(ac & dc) using operational amplifiers, gyro, resolver. Typical study of characteristics of these components. Concept of feedback as control theory-Mathematical theory of feedback, return ratio, return difference, open and closed loop, understanding the necessity of feedback as real control action supplemented by a small example.

Unit. 2 Time-Domain Analysis of Feedback Control Systems
Typical references test signals and their significance, transient behavior of closed loop systems under feedback control. Proportional plus derivative and rate feedback control actions for improving the transient response. Steady state behavior of closed loop feedback control systems. Types of open loop transfer functions. Steady state errors. Proportional plus integral control action for the improvement of steady state errors.

Unit. 3 Frequency-Domain Analysis of Feedback Control Systems
Concept of frequency-domain analysis, Bode plots, polar plots. Bode of closed loop transfer function and bode plots of error transfer functions, principle of argument, Nyquist criteria. Conditionally stable closed loop systems, transportation lag, constant M and constant N loci, Loci of closed loop poles (root loci).

Unit. 4 Compensation Techniques
Need for frequency-domain compensation, different types of compensation, phase lead and phase lag compensation, design of compensating networks for the desired frequency-domain close loop performance.

Unit. 5 State Space Method of Analysis
Fundamentals of state space: Concept of state variables. Representation of linear system through state dynamics, calculation of Eigen values and Eigen vectors, modal matrix, modal transformation, elementary understanding of controllability and observability, state feedback control. Stability analysis of feedback.

Control system-concept of stability: BIBO stability, asymptotic stability, Routh-Hurwitz analysis. Nyquist stability analysis and relative stability, gain margin and phase margin.

TEXT BOOKS
1. B.C. Kuo, *Automatic Control system*, Prentice Hall, 1975.
2. K Ogata, *Modern Control Engineering*, Prentice Hall of India Ltd., 2010.

REFERENCES

1. J.L. Melsa and D.G. Schultz, *Linear Control Systems*, McGraw Hill, 1970.

2. I.J. Nagrath and M. Gopal, *Control systems Engineering*, New Age International (P) Ltd., 1999.

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New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VI-Semester

BM602- Digital Signal Processing

UNIT-1. Discrete time signals & systems : Introduction, types of signals, discrete time signal sequences, discrete time systems, linear shift invariant systems, Stability & causality, linear constant coefficient difference equation, frequency domain representation of discrete time systems & signals, properties of the Discrete Time Fourier transform (DTFT), Sampling and discrete time processing of continuous-time signals.

UNIT-2. Z-Transform and Transform analysis of LTI systems: Z-transform, Inverse Z-transform, properties of Z-transform, one sided Z-transform and its applications, system function, frequency response of LTI systems, minimum phase and linear phase systems.

UNIT-3. Discrete Fourier transform(DFT), and its computation: Discrete Fourier Series, Discrete Fourier Transform, Linear convolution using Discrete Fourier Transform, Computation of DFT, Goertzel's Algorithm, Decimation in time FFT algorithms, Decimation in frequency algorithms, FFT algorithms for N (a composite number), chirp Z-transform algorithm.

UNIT-4. Implementation of digital filters: Signal flow graph representation, Realization of IIR & FIR systems, direct form, Transposed form, Parallel form, Cascade form, Lattice structure for IIR and FIR filters, Parameter quantization effect.

UNIT-5. Digital filter design techniques: Design of IIR digital filters using Impulse-invariant and bilinear transformation methods, Design of FIR filter using Windowing methods, Design examples.

Text Books:

1. Oppenheim & Schafer, Discrete Time Signal Processing, Pearson Education.

1. Proakis, Digital Signal Processing, Pearson Education.
2. MitraSanjit, Digital Signal Processing A Computer Based Approach, TMH

Reference Books:

1. Schaum's Outline Series, Digital Signal Processing.

2. Ludeman L.C., Fundamantels of DSP, John Wiley.

3. Farooq Husain, DSP and its Application, UmeshPubl, New Delhi.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VI-Semester

Departmental Elective BM603 (A) Data Communication

UNIT 1. Introduction to computer networks & their uses, Different topologies. ISO-OSI model: Layered Architecture, Peer-to-Peer processes and encapsulation, Function and Services of OSI layers; The Physical layer: Digital Signals, Transmission Impairments and Maximum data rate of a channel, Shennons theorem, Nyquist theorem. Transmission media: Guided and Unguided medias. Circuit, Packet and Message switching, virtual Circuit. Introduction to ISDN & its components.

UNIT 2. The data link layer: Design issues & function, Error detection & correction, Forward error correction Versus Retransmission, Hamming code & CRC codes, Framing: Fixed size and Variable size Frame, Bit stuffing and Byte stuffing. Data link layer protocols: Simplest, Stop and Wait, Sliding window protocols, PPP, SLIP, HDLC. The medium access sublayer: Static and Dynamic Channel Allocation, Protocols: ALOHA Protocol, CSMA (CSMA/CD, CSMA/CA), Collision Free Protocol- Bit Map.

UNIT 3. IEEE 802 standards for LANs (IEEE 802.3, IEEE 802.4, IEEE 802.5), LAN Devices: HUB, Switches- Learning, Cut-Through and store and forward switches, Bridges: IEEE 802.x to IEEE 802.y, Spanning Tree, Remote Bridge. Internetworking Devices: Routers & gateways. The network layer: Design issues and functions, Internal organization (Virtual Circuit & Datagrams).

UNIT 4. Routing algorithms: Shortest path routing, Flooding, LSR, Distance Vector Routing, Hierarchical Routing. Introduction to TCP/IP Protocol stack: Protocol Architecture, Classful IP addressing, ARP, RARP, IP Datagrams with options and its delivery, ICMP.

UNIT 5. Subnet, Supernet, CIDR. Transport Layer: Congestion control, Load Shedding, Jitter control, addressing and multiplexing, Connection establishment and connection release, flow control. Application layer: Introduction to DNS and Email.

TEXT BOOKS RECOMMENDED: 1. Tanenbaum A. S., “Computer Networks”, Pearson Education, 5th edition, 2011. 2. Behrouz A Forouzan, “Data communication and networking”, 4th edition, McGrawHill Education, 2017. 3. Comer, “Internetworking with TCP/ IP Vol-1”, Pearson education, 6 th Edition, 2015.

REFERENCE BOOKS:

1. Peterson & Davie, “Computer Networks”, 5th Edition, Morgan Kaufmann, 2011.

2. W. Richard Stevens, “TCP/IP Illustrated Vol-1 ”, 2nd Edition, Addison-Wesley, 2011.

3. Craig Zacker, “Networking The Complete Reference”, 2 nd Edition, TMH, 2001.

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New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VI-Semester

Departmental Elective BM603 (B) Embedded Systems

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, firewire, 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
1. F Vahid, T Giogarvis, *Embedded systems: A unified hardware/software approach*, Wiley, 1999.
2. 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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Biomedical Engineering, VI-Semester

Departmental Elective BM603 (C) Virtual Instruments

UNIT 1

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT 2

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT 3

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

UNIT 4

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

UNIT 5

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

TEXT BOOKS

1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

REFERENCE BOOKS

1. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
2. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.

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New Scheme Based On AICTE Flexible Curricula

Biomedical Engineering, VI-Semester

Open Elective BM604 (A) Bioinformatics

Unit. 1 Introduction to Bioinformatics
Objectives of bio-informatics, data integration, data analysis, bio-informatics databases and tools. Overview of bio-informatics application.

Unit. 2 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.

Unit. 3 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, multiple sequence alignment. Applications of multiple alignment.

Unit. 4 Gene Mapping and Gene expression
Applications of Gene mapping, DNA sequencing, DNA micro arrays, algorithms for gene alignment, genetic code.

Unit. 5 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. Phylogenetic trees: rooted and unrooted trees; UPGMA and Fitch- Margoliash method.

TEXT BOOKS

1. Dan E Krane Michael L Raymer, *Fundamentals Concept of Bioinformatics*, Pearson, 2003.
2. S. C. T. Rastogi, *Bio- informatics: Concepts, Skills and Applications*, CBS Publication.
3. S. Ignacimuthu, *Basic Bioinformatics*, Alpha Science International, 2004.

REFERENCES

1. David B Allison Grier P Page, *DNA Microarrays and Related Genomics Techniques*, Chapman & Hall/CRC, 1 ed., 2005.
2. Baxevanis, *Bio-informatics: A practical guide to the Analysis of Genes and Proteins*, Wiley, 3 ed., 2004.

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Biomedical Engineering, VI-Semester

Open Elective BM604 (B) Physiological modeling

UNIT I INTRODUCTION

System concept, system properties, piece-wise linear approximation, electrical analog for compliance, thermal storage, pulse response of first order systems, response of resistant and compliance system.

UNIT II TRANSFER FUNCTIONS

Transfer functions and its use, engineering concept in coupled system, example of Transformed signals.

UNIT III IMPEDANCE CONCEPT

Circuits for the Transfer function with impedance concept, prediction of performance, periodic signals.

UNIT IV FEEDBACK SYSTEMS

Characteristics of physiological feedback systems, uses and testing of system stability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS

Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, endocrinal system, functioning of receptors.

REFERENCES

1. William B.Blesser, “AS System approach to Bio-medicine”, McGraw-Hill book co., New York, 1969.
2. Manfreo clynes and john H.Milsum, “Bio-medical engineering system”, McGraw-Hill book co., NewYork, 1970.
3. Douglas S.Regs, “Control theory and physiological feedback mechanism”, The William & Williams co., Baltimore, 1970.

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Biomedical Engineering, VI-Semester

BM605- Modeling & Simulation

Unit. 1 Introduction to Simulation
Basics of modelling and simulation. Need of simulation.

Unit. 2 Basic Blocks of Simulink
Closed loop control system, integrators and derivatives, time response of second order system

Unit. 3 Physiological Modeling 1
Linear model of respiratory mechanics, linear model of muscle mechanics, steady –state analysis of the muscle reflex model. Regulation of glucose and insulin model, neuromuscular reflex model.

Unit. 4 Physiological Modeling 2
To determine the study-state operating point of ventilator control system, pupillary light reflex model.

Unit. 5 Designing and analysis of any physiological model.

TEXT BOOK
1. M.C. KHOO, *Physiological Control Systems: Analysis, Simulation and Estimation*, Wiley, 1999.

REFERENCES
1. Mark L, David A., *Learning Python*, Shroff, 2009.