RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Electronics and Instrumentation Engineering, VII-Semester

EI-7001 Biomedical Instrumentation

Unit. 1 Introduction to Human Physiology

Review: general human physiology, generation and transmission of action potential, depolarization and repolarization, evoked potentials. Physiology of heart: heart as pump. Various types of electrodes and their construction, performance and application, bioelectrical signals and their recording. Physiological transducers.

Unit. 2 Measurement and Recording of Physiology Signals

Signal condition and processing circuits for medical recording system. Bedside monitor, ECG machine and cardio scope blood flow meters, blood pressure and cardiac output measurement, measurement of heart sounds, plethysmography. Patient care and monitoring .central monitoring systems. Electrical safety of medical equipments.

Unit. 3 Therapeutic Equipments

Pacemakers – theory and design aspects, defibrillators, laser applications in biomedical field. Artificial kidney and dialyzers, X-ray machines and competent tomography, magnetic resonance and ultrasonic imaging systems, ultrasound in medicines. Introduction to thermography.

Unit. 4 PC Based Biomedical Instruments

Advanced microprocessor and PC based biomedical instruments. Biomedical telemetry. Introduction about body area network.

Unit. 5 Analytical Techniques

Electromagnetic radiation and its interaction with matter. Various components of optical spectroscopic instruments. Laws of spectroscopy. Absorption spectroscopy for UV, visible and IR region. Various sources and detectors and instrument designs. FTIR and its distinct applications. NMR spectroscopy and X- ray analysis, ion sensitive electrodes and their measurement chemistry analyzers. Introduction to Chromatography: Gas & Liquid.

TEXT BOOKS

1. John G. Webster, *Medical Instrumentation: Application and design*, 3rd ed., John Wiley, 2012.
2. Khandpur R.S, *Hand-book of Biomedical Instrumentation*, Tata McGraw Hill, 2nd Edition, 2003.

REFERENCES

1. Stuart R, MacKay, *Bio-Medical Telemetry: Sensing and Transmitting Biological Information from Animals and Man*, 2nd ed., Wiley, 1998
2. L. Cromwell, Fred J et al., *Biomedical Instrumentation and Measurements*, Prentice Hall, 1973.

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Electronics and Instrumentation Engineering, VII-Semester

EI-7002 Automation in Instrumentation

Unit-1. Automation: Definition of automation, types of automation, merits & demerits, application in instrumentation. Automatic test system configuration: GPIB bus talker/ listener/ controller, IEEE compatible programmable instruments, specification & operation.

(A) PC based instrument controller, computer controlled instruments system

(B) Programmable oscilloscope.

(C) Programmable function generator.

Automatic testing of electronic components:

(A) Operational amplifier.
(B) Digital integrated circuits.
(C) Sample & hold circuit/ switches/multiplexers.
(D) Instrumentation amplifier
(E) Switches in automated test systems.

Unit-2. Automatic performance evolution of electronic system & instrumentation:

(A) Data logger, programmable data logger configurations, SCADA & PLC systems.
(B) Operation of data logger, applications of data logging systems.

Automatic online condition monitoring:

(A) Condition monitoring, failure of plants/ components.
(B) Logical fault finding, maintenance logging, vibration monitoring, noise level, thermal sensing, infrared, ultrasonic condition monitoring, Quality control & automated inspection: Sensor technology for automated inspection, machine vision.

Unit-3. Microcomputer based numerical control system:

(A) Types of numerical control machines
(B) Part programming.
(C) Computer numerical control machine tools.

Unit-4. Virtual instruments: Basic components of virtual components, using virtual instruments.

Unit-5. Case studies: Hardware & software design of

(A) Bottle filling plant.
(B) automated guided vehicle system.

BOOKS & REFERENCES RECOMMENDED:

1. Kocher A.K. & Burns N.D., Microprocessors & their manufacturing applications

2. Mikell P. Groover, Automation, Production system & Computer integrated manufacturing, Pearson Education
3. Clyde F. Coombs, Jr editor in chief, electronic instrument handbook.

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Electronics and Instrumentation Engineering, VII-Semester

EI-7003 Simulation & Modeling

Unit-I

Introduction: objectives of modeling, System theory and state variables Type of Model: Analytic, Simulation, Measurement, Analytic Modeling, Probability theory, Random variables, Poisson process, Markov chains.

Unit-II

Queuing Theory: Little's Law, M/M/1, M/M/1/k, M/M/C, queuing Models, M/G/1[Impact variation in service times.

Unit-III

Petrinets: Stochastic Petrinets[SPN],GSPN.

Unit-IV

Simulation Modeling: Continuous and discrete event Simulation, Monte carlo Simulation, Pseudo random number generation, Non uniform Random variable Generation, Simulation Languages Features: Simpack, GPSS, GASP IV, CSIM, Estimation of Simulation Outputs/Output Matrix, confidence Intervals, Regenerative Simulation, Method of Batch Means.

Unit-V

Case Studies: Analytic Vs Simulation Models, Application to Operating Systems, Data bases, Networks Architectures.

References:

P.A. Fishwick Getting started with simulation programming in C & C++.
A. Narsingh Deo, Simulation with digi9tal computer.

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Electronics and Instrumentation Engineering, VII-Semester

Elective III EI- 7004 (1) VLSI Technology

Unit-1. Crystal Growth and Wafer preparation: Wafer terminology, Different crystalline orientations, CZ method, CMOS IC Design flow, Crystal Defects. Fabrication processes of FETs, MOSFETs, and BIMOS etc.

Unit-2. Layering: Epitaxial growth methods, Oxidation; Kinetics of oxidation, Thin film fabrication, Metallization; Physical Vapor Deposition, Sputtering.

Unit-3. Patterning: Lithography; Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. Photo masking steps, Resists. Doping: Diffusion; Diffusion Models, Ion Implantation; Implantation Equipment, Channeling.

Unit-4. VLSI process techniques and Integration: Floor planning, layout, Design rules, stick diagrams, Test generation, Logic simulation, Introduction to EDA tools. Contamination Control; Clean rooms, HEPA, ULPA Filters and Class numbers.

Unit-5. Subsystem Design: Data-paths; adder, Shift registers ALU, Memory; NVRWM, Flash memories, 6-Transistor RAMs. Latch up in CMOS Circuits.

BOOKS & REFERENCES RECOMMENDED:

1. S.K.Gandhi, VLSI Fabrication principles, Wiley.
2. S.M. Sze, VLSI Technology, II edition, McGraw Hill.
3. P.VanZant, Microchip Fabrication, A Practical Guide to Semiconductor Processing, Third Edition, McGraw Hill.

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Electronics and Instrumentation Engineering, VII-Semester

Elective III EI- 7004 (2) Intelligent Instrumentation

Unit-1. Introduction to Robotics: Robot classification, Robot mechanism, Mechanical & Electrical elements. Kinematics: Forward & Inverse Kinematics. Dynamics: Kinetic energy, potential energy, motion equation. Robot Sensors: Range, Proximity, Force, Torque, Ultrasonic, Optical sensors. Vision system: High level, Low level, Medium level vision, Edge detection method, Region growing method. Various Actuators: Hydraulic, Pneumatic, Electrical actuators. Principles of programmable robots, multiple robot control & Adaptive robots. Field applications of robot manipulator, Robot simulation & computer control.

Unit-2. Smart Systems: Various techniques of Interfacing with Smart instrumentation systems, Stepper motor Interfacing, Smart cards, Smart buildings, Smart cars etc.

Unit-3. Real time system: Hard & Soft RT'S, static & dynamic scheduling of RT'S e.g. of RT'S like railway reservation system, rocket launching system, pacemaker etc., Programmable Controller & their use in Instrumentation.

Unit-4. Expert system for real time control application. Knowledge base system: facts, rules, frames, inheritance. Fuzzy Logic: crisp logic, fuzzification, defuzzification, mamdani's method.

Unit-5. Artificial Intelligence & its requirement in Instrumentation: state space problem water jug problem, chess problem, production system, Problem characteristics, searching a tree: Uninformed search, informed search, Prolog programming: Marcus problem, family tree problem.

BOOKS & REFERENCES RECOMMENDED:

1. Robotics: Fu, Lee & Gonzalez.
2. Artificial Intelligence: Elaine Rich & Knight.
3. Turbo prolog: Townsend.
4. Intelligent Instrumentation: Barney.
5. Patterson, Artificial Intelligence & Expert system, Pearson Education
6. Luger, Artificial Intelligence, Pearson Education
7. handbook

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Electronics and Instrumentation Engineering, VII-Semester

Elective III EI- 7004 (3) Nuclear Instrumentation

Unit-I

General Introduction to Properties of Nuclear Systems and Radiation, Interaction of radiation with matter, Radioactive sources-Choice of isotopes.

Radiation detectors-Ionization chambers, Geiger-Muller counters, Scintillation counters, Semiconductor devices, Neutron detectors based on recoil, Measuring circuits including modulators, converters and stabilizers, Synchronous detectors.

Counting Statistics, Correlation sets, Standard deviation of rate meters, Error propagation, Effect of background, Statistical distribution of pulse height distribution, Detector efficiency.

Unit-II

Nuclear Reactor Instrumentation

Diffusion, moderation, absorption and delay processes, Neutron flux measurement, Control rod calibration, Nuclear fuel inspection and testing including poisoning, Radiation energy measurement, Remote control instrumentation, Nuclear instrument maintenance.

Unit-III

Application to industrial System

Radioactive Tracer technique, Gas and Liquid flow measurement, Leak detection, Residence time and its distribution, application to blending corrosion and wear studiesThickness and density measurement by beta rays, Gammaray absorption technique, measurement of thickness of surface material by back scattering.

Unit-IV

Level detection by radioactive devices, interface detection by neutron moderation technique.Measurement of gas pressure and gas analysers, Speceros-copic and frequency methods.Void detection, a idity meter, moisture meter, smoke detection, Ozonizer, Radiochromatography and interferometry.Portable instruments, Source activity for dynamic properties of instruments.

Unit-V

Safety

Hazards of ionization radiation, physiological effect of radiation, Dose and Risk, Radiological protection (Plpha, beta and Gamma, X, Neutron), Shielding material and effectiveness.

Operational safety instruments, emergency schemes, effluent disposal, Application to medical diagnosis and reatment.

References:

- Ed. Noltingk, B.E., "Instrumentation Reference Book, Butterworth Heinemenn.
- Boltan W., Newness, "Instrumentation and Measurement., Newness.
- Jones, "Instrumentation Series",

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Electronics and Instrumentation Engineering, VII-Semester

Elective IV EI- 7005 (1) Data Acquisitions Systems

Unit-1 Fundamentals of Data Acquisition Systems, Introduction, Sensors and Transducers, Temperature Sensors, Magnetic Field Sensors, Potentiometers, Light Detection, DAQ Hardware, DAQ Software, Communications Cabling, Noise, Parameters of a DAQ System, Accuracy and Precision, Noise, Settling Time, Acquisition Time, DC Input Characteristics, Configuration Considerations, Grounding Issues, Types of Measurement Systems, Measuring Signal Sources, DAQ Software, NI-DAQ, Measurement & Automation Explorer, Overview of NI-DAQmx VIs, NI-DAQmx Task State Model, Triggering, Analog Input, Anti-aliasing Filters, Using the DAQmx Read VI, DAQ Device Architectures, Multiple-Point (Buffered) Analog Input, Continuous Acquisition Flowchart, Overview of Signal Conditioning, Signal Conditioning Configuration, Signal Conditioning Functions, Filtering, Isolation, Transducer Conditioning, Thermocouples, Strain, Strain Gauge, Signal Conditioning for Strain Gauges, Strain Gauge Equations,

Unit-2 Data Acquisition Systems: Hardware , Introduction , Plug-in DAQ Systems , Signal Conditioning , Example of Design of a Signal Conditioning Circuit , Converters A/D , Parameters , Successive-Approximation ADC , Flash ADC , 8-Bit, 500 Msps Flash ADC of Maxim , Converters D/A, Parameters, Binary-Weighted-Input DAC, The R-2R DAC, 8-Bit DACs with 2-Wire Serial Interface of Maxim, MAX5893 High Speed A/D, Digital Signal Processing, Architecture of a DSP, Microprocessor and Microcontrollers, CPU Structure, Microcontrollers, Microcontroller MAXQ612/622, Amplifier, Design of Low-Noise Pre-amplifier, Low Noise Amplifier of the Maxim Integrated, MAX9632, Multiplexer/Demultiplexer, Multiplexer/Demultiplexer of Maxim, Integrated, MAX4638/4639.

Unit-3 Power Management, Automotive Power-Management MAX16920, Power-Management ICs for Single-Cell, MAX8662/MAX8663, Timing System, Timing Parameters for Combinational Logic, Timing Parameters for Sequential Logic, Clock Skew and Clock Jitter, MAX9155-Clock, Filtering, Digitally Programmed, Dual Second-Order, Continuous Low-Pass Filter, MAX270/271, Memory Board, 1024-Bit, 1-Wire EEPROM of Maxim Integrated, Bus Interface, MAX3421E, USB Peripheral/Host Controller with SPI Interface, Communication Bus, Bus USB and FireWire , Standardization and Technical Details , USB Connectors , Power Supply , USB Packet and Format , FireWire , USB Peripheral Controller with SPI Interface, MAX3420E , Serial Communications , Signal Description , Limitation of RS232 , MAX220-MAX249 for Serial Applications , Wireless, Ethernet, and Bluetooth , GSM for Data Acquisition Systems , GPS Receiver, MAX2769 , PCI and PCI Express , Standard VME.

Unit-4 Signal Processing, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Frequency Spacing and Symmetry of the DFT/FFT, Power Spectrum, About Spectral Leakage and Smoothing Windows, Characteristics of Different Types of Window Functions, Determining Which Type of Window To Use, Filtering, Ideal Filters, Practical (Nonideal) Filters, Advantages of Digital Filters over Analog Filters, IIR and FIR Filters, Infinite Impulse Response Filters, IIR Filter Comparison, Transient Response of IIR Filters, Finite Impulse Response Filters, Analog Output Architecture, Using the DAQmx Write VI, Multiple-Point (Buffered) AO VIs, Finite Buffered Generation, Continuous Buffered Generation, Digital Signals, Digital I/O, Counters Signals, Counter Chips, Counter I/O, Edge Counting, Advanced Edge Counting, Pulse Generation, Pulse Measurement, Frequency Measurements, Position Measurement, Synchronization, Explicit State Transitions, Single Device Synchronization, Multiple Device Synchronization.

Unit-5 Design of Data Acquisition Systems, Introduction to the Design, Functional Design of High Speed Computer-Based DAS, Requirements, Analysis of Accuracy (Static), Analysis of Accuracy (Dynamic), Portable DAS, Design Guidelines for High-Performance, Multichannel, Software for Data Acquisition Systems, Introduction, LabVIEW, Android for DAQ, Design of Firmware, Example of Implementation of a Software, for Data Acquisition System via VME Bus, Smart Data Acquisition System, General Description of MAX1329, Circuit Application, Complete DAQ.

BOOKS & REFERENCES RECOMMENDED:

1. Data Acquisition Systems from Fundamentals to Applied Design, Di Paolo Emilio, Maurizio, Springer, New York..
2. Data Acquisition for Sensor Systems, Taylor, H.R, Springer US Practical Data Acquisition for Instrumentation and Control Systems, John Park, ASD, IDC Technologies, Perth, Australia
3. Data Acquisition and Signal Conditioning Course Manual, National Instruments Corporate Headquarters, Texas, USA

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Electronics and Instrumentation Engineering, VII-Semester

Elective IV EI- 7005 (2) Safety & Reliability

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. Satand 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, censoring and accelerations ,parametric methods.

Text books

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

Reference books

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

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Electronics and Instrumentation Engineering, VII-Semester

Elective IV EI- 7005 (3) AERONAUTICAL INSTRUMENTATION

Unit-1 New vision for future aerospace vehicles and systems, Revolutionary vehicles, Smart vehicle,Heal thyself, Working for more secure airspace, , The turbojet, The turbofan, The turboprop, Gasturbine component technology, Real gas properties, Ramjets and Scramjets, Reciprocating engines, Aircraft engine emissions and Fuels, Engine noise.

Unit-2 Rockets and launch vehicles, Rocket science Structural considerations, Structural dynamics, Spacecraft structures, Aerodynamics, Performance and stability and control, Aerodynamics, Airplane performance, Aircraft stability and control.

Unit-3 Avionics and astrionics, The electromagnetic spectrum, The spacecraft environment, Aircraft environment, Electromagnetic compatibility, , Equipment/furnishings, Fire protection, Flight controls, Fuel, Hydraulic power, Ice and rain protection, Landing gear, Lights, Oxygen, Pneumatic, Water/waste, Airborne auxiliary power, Avionic systems.

Unit-4 Aeronautical design, Definitions, Introduction, , Lighter-than-air vehicles (lta), V/stol air vehicles, Performance, Astrodynamics, Notation, Orbital mechanics, Orbital maneuvers, Earth orbiting satellites,

Unit-5 Payload management, Human factors, Risk management, Aircraft accident and incident investigation, Aircraft maintenance, The economics of maintenance, National and international regulations, Maintenance programs.

Books & References recommended:

1. Standard Handbook for Aeronautical and Astronautical Engineers, Mark Davies, McGraw-Hill,
New York.
2. Aerospace Instrumentation by M. A. Perry and Published by Elsevier