EIC-701

Optical Instruments and Sensors

UNIT 1**:**

Introduction to vector nature of light, Propagation of light, Propagation of light in a cylindrical dielectric rod, ray model, wave model. Theory of image formation, Review of aberration, Comma, acclamation, distortion, Chromative aberration, Osages.

UNIT 2:

Different types of optical fibres, model analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation.

UNIT 3:

Optical fiber in instrumentation use of optical fibers as sensors, modulation techniques for sensors fiber optic power measurement. Stabilized calibrated light sources end-to-end measurement of fiber losses, optical signal processing.

UNIT 4:

Optical power meters, optical attenuators, optical spectrum analyzer, optical switching & logic gate and measurement techniques like optical time domain reflectometry, (OTDR), attenuation measurements

UNIT 5:

Optical Sources & detectors: LED and LASERS, photo detectors, pin detectors detector responsitivity – noise, optical receivers. Integrated optical devices

References:

1.An Introduction to Fiber Optics by Cherin.

2.Optical fiber – System Technology, design and applications by C.K. Rao.

3.Optical Fiber Sensors, Vol.12 by Culshaw B. and Dakin J. (Ed.), Arctech House.

4.Fundamentals of Fiber Optics in Telecommunications and sensor, by B.P. Pal, Wiley Eastern

5.Optical Fiber Communication by G. Kelser, McGraw Hill.

List of Experiments:

1) Setting up Fiber Optic Analog Link and Digital Link.

2) Study of Intensity Modulation Technique using Analog input signal.

3) Pulse Width Modulation in Fiber Optic Link.

4) Measurement of propagation or attenuation loss in optical fiber.

5) Measurement of bending loss in optical fiber.

6) Numerical Aperture (NA) of the fiber.

7) Study of Diffraction gratings.

8) Study of Michelson Interferometer.

9) Study of Reflection Holography.

10) Study of Transmission Holography

EIC-702

Virtual Instrumentation

UNIT 1:

Representation of analog signals in the digital domain – Review of quantization in amplifier and time areas, 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 multichannel 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 – RS 232C, RS – 422, RS 485 and USB standards – IEEE 488 standard –ISO –OSI model for series 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 VIs – Display types – Digital – Analog – Chart – Oscilloscope types – Loops – Case and sequence structures – Types of data – Arrays – Formulate 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 – PID 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.

List of Experiments:

1) To review background information required for studying virtual instrumentation.

2) To study the basic building blocks of virtual instrumentation.

3) To study the various techniques of interfacing of external instruments of PC.

4) To study the various graphical programming environment in virtual instrumentation.

5) To study a few applications in virtual instrumentation.

EIC-703

Industrial Instrumentation

UNIT 1:

Introduction to industrial symbols and standards, classification of industry type of measurement required; detectors, probe analyzers, actuators-principles and applications. Measurement of weight- Load cell method, strain gauge, LVDT; piezoelectric, pneumatic and hydraulic load cell, null balance method.

UNIT 2:

Temperature measurements: Standards and calibration, thermal expansion methods, bimetallic thermometer, thermocouple, reference, electrical resistance sensors -conductive sensor (resistance thermometers), bulk semiconductor sensors thermistors), Radiation thermometers, automatic null balance radiation thermometers.

UNIT 3

Junction considerations, special materials, configuration & techniques, Measurement of thermocouple output .Units of pressure and vacuum: dead weight gauges & manometer dynamics; Different type of manometers, diaphragm gauges bellows and force balance type sensors, Boudern gauge, Piezoelectric, Capacitive and Inductive Pressure pickups. Vacuum pressure measurements:

UNIT 4:

Variable area meters (rotameter), turbine meters, Electromagnetic flow meters, Differential pressure flow meters: Bernoulli's theorem: pituttube, orifice, vanturi, flow nozzle, Hot wire and hot film anemometers Ultrasonic flow meters. Drag force flow meters, vortex shedding flowmeters. Measurement of level, Float type gauge, purge method, differential pressure method, conductive and capacitive method; electromechanical method.

UNIT 5:

Measurement of Moisture, Thermal Dying Method, DistillationMethod, Chemical Reaction Method, Electrical Method.Measurement of viscosity, definition of absolute and kinematic viscosity, industrial viscosity meter.

Text Book:

1. E. O. Doebelin, "Measurements systems: Applications and Design", McGraw Hill

Publication.

2. D. P. Eckman, "Industrial Instrumentation", Wiley Publication.

Reference Book:

1. T. G. Beckwith, R. D. Maragoni and J. H. Lienhard, "Mechanical Measurements", Pearson

Publication.

2. B. C. Nakra and K. K. Chaudhry, "Instrumentation: Measurements & Analysis" Tata

McGraw Hill Publication.

List of Experiments:

1. Instrumentation Amplifier: Design for specific gain and verification of CMRR.

2. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/ 8 bit systems.

Observe the Quantization noise in each case.

3. Study of Storage Oscilloscope & Transient response of RLC.

4. Convert a given AC Analog signal into digital using S/H & ADC and recover the analog signal using DAC IC.

5. Study of Characteristics of a Strain Gauge.

6. Construction of chopper amplifier.

7. Study of low noise and low frequency amplifier for biomedical application.

8. Study of Piezoelectric transducer.

9. Study of Capacitive and Inductive Pressure pickups.

EIC-704(A)

Nano Science

UNIT -1:

Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrahedral bounded semiconductor structures; lattice vibrations. Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces Localized Particles: Acceptors and deep taps; mobility.

UNIT-2:

Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano Sheet), Quantum confinement effect in Nano materials. Quantum Wells, Wires and Dots Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared erectors; Quantum dot laser Superconductivity.

UNIT-3:

Growth Techniques of Nanomaterials Lithograpahic and Non litho grapahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique(p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapor Deposition CVD), Synthesis of carbonnano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition.

.

UNIT -4:

Methods of Measuring Properties:Structure: Crystallography, particle size determination, surface structure,Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM)FieldIon Microscopy, Scanning Electron Microscopy,TransmissionElectronMicroscopy (TEM)Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luminescence.

UNIT-5

Buckey Ball:

Nano structures of carbon (fullerene):Carbon Nano-tubes: Fabrication,structure .Electrical, mechanical, and vibrational properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Molecular machine, Nano-Biometrics, Nano Robots.

Text/Reference Books:

1. C.P.Poole Jr F.J. Owens, "Introduction to Nanotechnology".

2. "Introduction to S.S. Physics" - (7th Edn.) Wiley 1996.

3. S. Sugano & H. Koizuoni, "Microcluster Physics" –Springor 1998

4. "Handboole of Nanostructured Materials & Nanotechnology" vol.-5. Academic Press 2000.

EIC -704(B)

Microcontrollers for Embedded System

UNIT 1:

Introduction: Microcontrollers and Embedded systems, Overview of the 8051,Inside the 8051, Addressing modes, assembly programming, 8051 data types and directives, Interfacing with 8051, Programming the 8051 timers.

UNIT 2:

MSP430x5x series block diagram, address space, on-chip peripherals (Analog and Digital), and Register sets. Instruction set, instruction formats, and various Addressing modes of 16-bit microcontroller; Sample embedded system on MSP430Microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.

UNIT 3:

Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control,timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.

UNIT 4:

Serial communication basics, Synchronous/Asynchronous interfaces (like UART,USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

UNIT 5:

Internet of Things(IoT) overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.

Text Book:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D ― The 8051 Microcontroller

and Embedded Systems using Assembly and C‖, Pearson Publication.

2. John H Davies, ―MSP430 Microcontroller Basics‖ Newnes Publication.

Reference Book:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide.

EIC-704 (C)
Analog Signal Processing

UNIT 1:

Introduction to domains and the analogue/digital trade off, Introduction to basic building blocks: null or, voltage feedback amplifier, operation trans conductance amplifier, current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations.

UNIT 2:

First-order and second-order filter realization, filter design parameters (Q and ω0), Frequency response, and effect of finite gain of op-amp, realization of Single-Amplifier Biquad and General Impedance Convertor circuit.

UNIT 3:

Ideal low-pass filter, Butterworth and Chebyshev magnitude response, pole locations, low-pass filter specifications.

UNIT 4:

Delay equalization: equalization procedures, equalization with first-order and second-order modules, strategies for equalization design. Definition of Bode sensitivity.

UNIT 5:

Properties of Lossless ladders, the general impedance convertor (GIC),optimal design of the GIC, realization of simple ladders, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique ,creating negative components.

Text Books:

1. R. Schaumann and M.E. Valkenberg,"Design of Analog Circuits", Oxford University Press.

EIC-705(A)

Space Science

UNIT 1:

Introduction to space science and applications,historical development.

UNIT 2:

Solar System :Nebular theory of formation of our Solar System .Solar wind and nuclear reaction as the source of energy .Sun and Planets: Brief description about shape size, period of rotation about axis and period of revolution, distance of planets from sun, Bode's law, Kepler's Laws of planetary motion, Newton's deductions from Kepler's Laws, Newton's Law of gravitation, correction of Kepler's third law, determination of mass of earth, determination of mass of planets with respect to earth. Brief description of Asteroids, Satellites and Comets.

UNIT 3:

Stars:Stellar spectra and structure, stellar evolution, nucleo-synthesis and formation of elements .Classification of stars: Harvard classification system, Hertzsprung -Russel diagram,Luminosity of star, variable stars; composite stars (white dwarfs, Neutron stars, blackhole, star clusters, supernova and binary stars); Chandrasekhar limit.

UNIT 4:

Galaxies:Galaxies and their evolution and origin, active galaxies and quasars.

UMIT 5:

Creation of Universe:Early history of the universe, Big-Bang and Hubble expansion model of the universe,cosmic microwave background radiation, dark matter and dark energy.

Text Books / Reference Books:

1. K. S. Krishnaswami, "Understanding cosmic Panorama New Age International.

2. K. S. Krishnaswami, "Astrophysics: A modern Perspective" New Age International.

EIC-705(B)

LASER System and Applications

UNIT 1:

Basic Principle of Modern Physics: Black body radiation, Atomic structure, Spectral series of hydrogen atom, Polarization, Absorption and florescence of X-ray, Energy distribution in electrons, Probability of distribution of free electrons, Free electron in metals, Energy level in free electrons, Application of Schrodinger equation in potential well, potential step,tunneling effect.

UNIT 2:

Elements and Techniques of Laser: Concept of coherence, Temporal and Spatial coherence, Coherence length and time, Brightness and Intensity, Directionality and Monochromacity. Absorption, Spontaneous and Stimulated Emission process and Einstein's coefficients. Population inversion, Pumping and pumping schemes, laser gain, Optical cavities and its types.

UNIT 3:

Principle of Laser & General Lasers: Main components of Laser, Principle of Laser action, Introduction to general lasers and their types. Three & four level Lasers, Continuous Wave Lasers, Pulsed Lasers, Q-switch lasers.

UNIT 4:

Types of Laser Systems:Solid state Lasers: Neodymium laser, Nd-Yag laser, Nd-Glass laser and Alexandrite laser.Liquid Lasers: Dye laser, Tuning in Dye laser, Model-Locked Ring Dye laser.Gas Laser: Ionic lasers, Argon ion laser, Krypton ion laser, He-Cadmium laser, Copper vapour laser, Carbon dioxide laser and Excimers laser.Semiconductor Laser: Characteristics of semiconductor lasers, Semiconductor diode lasers,Hetrojunction lasers, Homojunction lasers, Quantum well lasers.

UNIT V

Laser Applications:

Material Processing: Material processing with lasers, Interaction mechanism, Material

processing mechanism, Drilling, Cutting and Welding process with laser. Laser

hardening .Medical Science: Medical lasers, Laser diagnostic, Laser in ophthalmology, laser in glaucoma, Laser for general surgery, Laser in dermatology, laser in dentistry, Laser in medicine.Optical Communication: Optical source for fiber optical communication, powering and coupling, Transmission, Hologram their characteristics. LIDAR.

Reference Books:

1.KR Nambiar, "Laser Principles, Types and Application" New Age International.

2. SA Ahmad, "Laser concepts and Applications" New Age International.

EIC-705(C)

Intelligent Instrumentation

UNIT 1: Introduction: Introduction to intelligent instrumentation, Historical Perspective, Current status, software based instruments.

UNIT 2:Virtual Instrumentation :Introduction to graphical programming, dataflow & graphical programming techniques, advantage of VI techniques, Visand sub VIs loops and charts, arrays, clusters and graphs, case and sequence structure, formula nodes, string and file I/O, Code links Interface Nodes and DLL.

UNIT 3:Data Acquisition Methods: Analog and Digital IO, Counters, Timers, Basic ADC designs, interfacing methods of DAQ hardware, software structure ,use of simple and intermediate Viz. Use of Data Sockets for Networked Communication and controls.

UNIT 4:PC Hardware Review and Instrumentation Buses: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, and PCMCIA Buses.IEEE488.1 & 488.2 serial Interfacing-RS 232C, RS422, RS423, RS485,USB, VXI, SCXI, PXI.

UNIT 5:Smart Instruments: Smart/intelligent transducer comparison with conventional transducers self-diagnosis andremote calibration features — smart transmitter with HART communicator .Micro Electro Mechanical Systems — sensors, nonlinearity compensation.

Text Books:

1. G.C. Barney," Intelligent instrumentation: microprocessor applications in

measurement and control", Prentice Hall Publication.

2. Jovitha Jerome," Virtual Instrumentation using Lab VIEW", PHI Publication.

Reference Book:

1. Lisa, K.Wells & Jeffery Travis," Lab VIEW For everyone", Prentice Hall, Publication.

2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill Publication.

3. E. O. Doebelin, "Measurement systems", McGraw Hill Publication.

4. P. Chapman, "Smart Sensors", ISA Publication.

EIC-706(A)

Entrepreneurship Development

UNIT 1:

Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend‟s Achievement

motivation theory), Types of entrepreneur, According to Type of Business, Use of Technology,

Motivation, Growth, Stages, New generations of entrepreneurship viz. social entrepreneurship,

Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship

etc., Barriers to entrepreneurship conceptual model of entrepreneurship , entrepreneur v/s intrapreneur;

UNIT 2:

Classification of entrepreneurs; Entrepreneurial Development Programmes- their

relevance and achievements, Role of government in organizing such programmes, Women

Entrepreneurs : Present status in India ; steps being taken for their promotion. Small Business : Concept & Definition, Role of Small Business in modern Indian

Economy, Small entrepreneur in International business; Steps for starting a small industry,

registration as SSI, Role of SIDBI; advantages and problems of SSIs.

UNIT 3:

Project: Definition, characteristics, types, steps in identification of projects, project

life-cycle. Project management: meaning, scope & importance, role of project manager; Project

appraisal: Preparation of a real time project feasibility report containing Technical appraisal,

Environmental appraisal, Market appraisal (including market survey for forecasting future

demand and sales) and Managerial appraisal.

UNIT 4

:Idea Selection, Selection of the Product / Service,Aspects of a Project, Phases of a Project, Project Report, Contents of a Project Report, Proforma of a Suggested Project Report for a manufacturing Organization

UNIT 5:

Implementation of projects: Graphic Representation of Project Activities, Network Analysis, Management & control of projects, Project scheduling, MIS in project, problems of project implementation, project audit.

Text Books:

1. Kenneth R., Van Voorthis, Entrepreneurship and Small Business Management.

2. Prasanna Chandra , Projects : Planning, Analysis, Selection, Implementation & Review , Tata McGraw Hill

Reference books:

1. C.B. Gupta & N.P. Srinivasan, Entrepreneurial Development.

2. P.Gopala Krishnan & V.E Rama Moorthy , Project Management, MacMillan India

3. Maylor, Project Management.

EIC-706(B)

Artificial Intelligence

Unit 1:

Introduction : Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Unit 2:

Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.

Unit 3:

Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit 4:

Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning,

Unit 5:

Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

References:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education

2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill

3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education

4. Dan W. Patterson, “Artificial Intelligence and Expert System.

EIC-706(C)

Data Compression

UNIT 1:

Compression Techniques: Loss less compression, Lossy Compression, Measures of predominance,

Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models ,Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.

Unit 2:

The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding:Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.

Unit 3:

Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary.The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression.

Unit 4:

Distortion criteria, Models, Scalar Ouantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.

Unit 5:

Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm,Tree structured Vector Quantizers. Structured Vector Quantizers.

References:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers

EIC-706(B)

Software Quality Engineering

UNIT 1:

Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality ,Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement And Inspection Process, Documents and Metrics.

UNIT 2:

Software Quality Metrics Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance:

.UNIT 3:

Software Quality Management and Models Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

UNIT 4:

Software Quality Assurance Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

UNIT 5:

Software Verification, Validation & Testing:Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

References:

1. Jeff Tian, Software Quality Engineering (SQE), Wiley

2. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley s", Prentice Hall of India.