EI- 801 – Optical Instruments and Sensors

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

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

Unit-V
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
6. Liu- Principles & Application of Optical Communication 1st ed., TMH
7. Ghatak- Optics 4th ed., TMH
8. Keiser- Optical Fiber Communication 4th ed., TMH

LIST OF EXPERIMENTS
Optical Instrumentation and Sensors
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

EI- 802 – Digital Control Systems

Unit-I

Modeling of Digital Control System Block diagram of sampled data / digital control system, Discrete LTI systems characterized by difference equations Sampling process and its frequency domain analysis, Idea sampler, Sampling theorem & Nyquist frequency, Data conversion techniques uses of A/D, D/A and ZOH elements.

Unit-II

Discrete System Modeling Definition and determination of the Z-plane and Z-transform, Mapping between S-plane and Z-plane, Z-transform theorems, The inverse Z-transform, Z-transform of system equations, Solution of linear difference equations using Z-transform, The pulse response, Block diagram reduction for systems interconnected through samplers, Signal flow graphs for hybrid systems.

Unit-III

Discrete Control Analysis Stability studies using Routh's test & Jury's test, Steady state error Analysis for stable systems, Root locus Analysis, Correlation between time Response & frequency response.

Unit-IV

Discrete Transform Analysis Folding / Aliasing, Transformation Methods between planes (s, z and w), Numerical solution differential, Equations, Jordon transformation, Backward forward & canonical difference, Pseudo continuous-time (PCT) Control system.

Unit-V

Discrete state Variable Analysis State variable representation, Time domain state and output equations for sampled data control system, State variable representation of a discrete time SISO system using phase variables - canonical variables - physical variables, State transition equation, State variable representation in the z-domain, System stability, Time response between sampling instants.

References:

 Kuo, “Digital Contr
 ol System”, Oxford Press.
 Ogata, “Digital Control System”, PHI.
Gopal M., “Digital Control System”, TMH.
 Santina, Subberud and Hosteller, “Digital Control System Design”, Oxford University Press.
 Chen, “Analog & Digital Control System Design, Oxford University Press.

List of Experiments

1. Overview of the MATLAB Environment for control system.
2. Step Response of 1st and 2nd order systems in MATLAB.
3. Analysis and Designing of bode plot using MATLAB.
4. Analysis and Designing of Root locus using MATLAB.
5. Introduction to Simulink for Control System.
6. To study of PID controller with Simulink.
7. Introduction of State Spaces design in MATLAB.
8. Test of Controllability and Observability.
9. Determination of state transition matrix
10. Introduction to LTI viewer.
11. Design of digital compensators, Lag, Lead-Leg.

EI- 8301 – 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.

EI- 8302 – Embedded Systems

Unit-I

8 Bit Micro controllers: Introduction to MCS-51 family, Peripheral of MCS-51 family, PIC Micro Controller –CPU architecture, registers, instruction sets addressing modes, loop timing, On chip Peripherals of PIC, Motorola MC68H11 Family Architecture Registers, Addressing modes, Interruptsfeatures of interrupts- Interrupt vector and Priority, timing generation and measurements, Input capture, Out capture.

Unit-II

16 Bit Micro controller: Introduction to MCS-96 family, Peripherals of MCS-96 family, 80196-architecture, CPU operation, memory organization, I/O port, Operand addressing, instruction set, Interrupts, On chip Peripherals-PWM, Timers, HIS/HSO, Serial Port, External memory interfacing.

Unit-III

32 bit Micro controller: Intel 80960-architecture, memory address space, Salient features of ARM processor family-ARM7 /ARM9/ ARM9E/ ARM10/ ARM11/ SecureCore /Strong ARM, XScale technology, ARM9200 Architecture,Pinouts, Peripheral Identifier, System Interrupts, External Interrupts, Product memory mapping, External memory mapping, Internal memory mapping, On chip Peripherals-Memory controllers, external Bus Interface(EBI), Advanced interrupt controller(AIC), USART, Timer counter.

Unit-IV

Software development and tools: Embedded system evolution trends. Round- Robin, Roundrobin with Interrupts, function- One- Scheduling Architecture, Algorithms. Introduction toassembler- compiler- cross compilers and Integrated Development Environment (IDE) Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

Unit-V

Real Time Operating Systems: Task and Task States, tasks and data, semaphores and shared Data Operating system Services- Message queues- Timer Function- Events- Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS.

References:

· David E Simon, " An embedded software Primer" Pearson education Asia.
· John B Peat man " Design with Micro controller" Pearson education Asia.
Jonartthan W. Valvano Brooks/cole " Embedded Micro Computer Systems. Real time Interfacing", Thomson learning

EI- 8303 – Intelligent Instrumentation

Unit-I

Intelligent versus Dumb instruments, A historical perspective of instrumentation systems. Review of digital transducers. Interfacing micro computers. Computer ports to high power devices. Optical shaft encoder communication standards. Concepts of Real Time system and its application.

Unit-II

Details of Data Acquisition systems (DAS) Logic control systems, Continuous & Batch modes, Single and multi loop controller. Details of Data logger and its application.

Unit-III

Architecture of Virtual instrument and its relation to operating system. Software overview: LABVIEW, Graphical User Interface (GUI), Control and indicators: G programming- Data type, Data flow programming editing and running a virtual instrument.

Unit-IV

G Programming details in LABVIEW, G Programming tools and libraries. Programming structure: For loop, While loop. CASE structure, Sequence Structure arrays and clusters. Array operations- Bundle/Unbundled String and file I/O. High level and low level I/Os. Attribute nodes, Local and global variables.

Unit-V

Software development for Temperature (Low and High), Level, Speed, pressure etc.

References:

- Barney G C, Intelligent Instrumentation : Micro processor application in measurement and control,
Prentice Hall, Engle Wood Cliff NJ.
- H S Store, Micro Computer Interfacing, Addison Wesley, Reading, MA
- Rathore T S, Digital Instrumentation, TMH
- Interfacing sensors to the IBM PC, Prentice Hall, Engle Wood Cliff NJ.
- Garry M. Johnson " LAB view Graphical Programming", TMH.
- Lisa K. Wells "Labview for Every one, PHI.
- Barry Paton, "Sensor, Transducers and Labview", Prentice Hall.

EI- 8304 – 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",

EI- 8401– Fuzzy Logic & Neural Networks

Unit-I
Fuzzy system introduction, Fuzzy relation, Membership function, Fuzzy matrices and entropy, Fuzzy operation and composition.

Unit-II
Fuzzy Variables, Linguistic variables, measures of fuzziness, concepts of defuzzification, Fuzzy control applications.

Unit-III
Fundamentals of Artificial Neural networks- Biological prototype – Artificial neuron, Activation functions, Single layer and multiplayer networks. Training Artificial neural networks, Preceptrons, Exclusive Or Problem – Linear seperability, Storage efficiency, Preceptron learning, perceptron training algorithms. Back propagation, Training algorithm, network configurations, Network paralysis, Local minima, temporal instability.

Unit-IV
Counter propagation networks, Kohonen layer, Training the kohonen layer, Pre processing the inputted vectors, Initialising the wright vectors, Statistical properties, Training the grosberg layer. Full counter propagation networks, Applications.
Statistical methods, Boltzman training, Cauchy training, Artificial specific heat methods, Applications to general non-linear optimization problems. Back propagation and cauchy training.

Unit-V
Hopfield nets, Recurrent networks, Stability, Associative memory, Thermodynamic systems, Statistical Hopfiled networks, Applications. Bi-directional associative memories, Retrieving on stored association, Encoding the associations.

References :

- Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall.
- Zmmermann H.J., “Fuzzy Set Theory and its Applications”, Allied Publishers Ltd.
- Klir G.J., and Folger T., “Fuzzy Sets, Uncertainty and Information”, Prentice Hall.
- Limin Fu., “Neural Networks in Computer Intelligence”, McGraw Hill.
- Zuroda J.M., “Introduction to Artificial Neural Systems”, Jaico Publishing.
- Haykin S., "Artificial Neural Network: A Comprehensive Foundation: Asia Pearson Pub.

EI- 8402– Digital Image Processing

Unit-I

Digital Image Processing- Elements of a Digital Image Processing system, Structure of the Human eye, Image formation and contrast sensitivity, Sampling and Quantization, Neighbours of a pixel, Distance measures, Photographic file structure and exposure, Filem characteristics, Linear scanner, Video camera, Image processing applications.

Unit-II

Image Transforms-Introduction to Fourier transform-DFT, Properties of two dimensional FT, Separability, Translation, Periodicity, Rotation, Average value, FFT algorithm, Walsh transform, Hadamard transform, Discrete Cosine transform.

Unit-III

Image Enhancement- Definition, Spatial domain methods, Frequency domain methods, Histogram modify technique, Neighborhood averaging, Media filtering, Lowpass filtering, Averaging of multiple images, Image sharpening by differentiation and high pass filtering.

Unit-IV

Image Restoration-Definition, Degradation model, Discrete formulation, Circulant matrices, Block circulant matrices, Effect of diagnolization of circulant and block circulant matrices, Unconstrained and constrained restorations , Inverse filtering, Wiener filter, Restoration in spatial domain.

Unit-V

Image Encoding-Objective and subjective fidelity criteria, Basic encoding process, The mapping, The quantizer, The coder, Differential encoding, Contour encoding, Run length encoding, Image encoding relative to fidelity criterion, Differential pulse code modulation.

References:

- Rafael, C. Gonzlez., and Paul, Wintz, “Digital Image Processing”, Addison-Wesley Publishing Company.
- Jain Anil K., “Fundamentals of Digital Image Processing”, Prentice Hall.
- Sosenfeld, and Kak, A.C., “Digital Image Processing”, Academic Press.
- William K. Pratt., “Digital Image Processing”, John Wiley and Sons.

EI- 8403– Advance Industrial Electronics

Unit-I

Introduction to modern power conductor devices: Gate turn off thyristor (GTO), Insulated Gate Bipolar Junction Transistor (IGBT), Power BJT, Power MOSFET, MOS controlled thyristor (MCT), Reverse conducting thyristor (RCT), Smart Power Devices (Power ICs) Rating, Static and dynamic characteristics, Safe operating areas, Protections of devices, Devices selection.

Unit-II

DC to DC conversion, Buck Boost and Buck Boost converters (Circuit Configuration and analysis with different types of loads) Power factor, Harmonics and effect of source inductance in converter circuits. Resonant DC, DC converters. Switched mode power supply (SMPS).

Unit-III

Concept of PWM in converters, Unity power factor converters, Voltage source inverters (VSI), Current source inverters (CSI). Application of VSI and CSI in induction motor control.

Unit-IV

Non Drive applications of power electronics inverters, Uninterrupted power supply (UPS), Induction heating, Metal cutting, Active power line conditioning.

Unit-V

Vector controlled and slip power controlled induction motor drives, Application of microprocessor, Micro controllers and DSP in Machine drives.

References :

- MH Rashid, Power Elex, PHI
- J.G. Kassakian, MF Schlecht and G.C. Verghese "Principle of Power Electronics", Reading, MA, Addison Wesley.
- Dubey G.K., " Power Semiconductor Controlled Drives", Engle Wood Cliffe NJ, Prentice Hall.
- DC Griffith, " Uninterruptible power supply", Marcell Dekker, NY.
- P. Vas, "Vector control of AC motors", Oxford Press.

EI- 8404– DSP Processors

UNIT I :

An introduction to DSP Processors: Advantages of DSP ,characteristics of DSP systems ,classes of DSP applications.DSP processor embodiment and alternatives,Fixed Vs Floating point processors,fixed point and floating point data path.

UNIT II :

DSP Architecture : An intoduction to Harvard Architecture,Differentiation between Von-Neumann and Harvard Architecture,Quantization and finite word length effects,Bus structure ,Central Processing unit – ALU ,Accumulators ,Barrel shifters, MAC unit,compare ,select ,and store unit (CSSU) ,data addressing and program memory addressing

UNIT III :

Memory architecture :Memory structures ,features for reducing memory access required ,wait states,external memory interfaces,memory mapping – dta memory,programmemory,I/O memory memory mapped registers .Addressing: Various addressing modes –implied addressing,immediate data addressing,memory direct addressing ,register direct and indirect addressing and short addressing modes.

Instruction set : Instruction types , various types registers,orhogonality assembly language and application development.

UNIT IV:

Execution Control and pipelining : Hardware looping , interrupts, stack , pipelining and performance, pipelining depth, interlocking , branching effects, interrupt effects, instruction pipelining,. Peripherals: Serial ports, timers, parallel ports, Bit input/output ports, Host ports, communication ports, on-chip A/D and D/A converters, external interrupts, on-chip debugging facilities, power consumption and management.

UNITV:

Processors:Architecture and instruction set of TMS320C3x, TMS320C5x, TMS320C6x,ADSP21xx DSP chips, some examples programs.Recent trends in DSP system Design: FPGA based DSP system design, advanced development tools for FPGA, development tool for programmable DSP's- An introduction to Code composer studio.

References :

1.P.Lapsley, J. Bier,A.Shoham,E.A.lee:DSP processor fundamentals:Architectures and Features,IEEE
Press series on signal processing,IEEE.
2. B venkataramani and M bhaskar: Digital signal Processors: Architectures, programming and applications,TMH.