Department of Instrumentation

M.Tech. Instrumentation Technology

Syllabus

(2017 Onwards)

Cochin University of Science and Technology

Cochin – 682 022

M. Tech. in Instrumentation Technology
Course Structure

Semester I

Sl. No.	Course Code	Name of the Course	Core / Elective	Credits	Hours/week			CBCS	Marks
					L	T	P		
1	INS 3101	Intelligent Techniques in Instrumentation	C	4	4				100
2	INS 3102	Advanced Sensor Technology	C	4	4				100
3	INS 3103	Adaptive and Robust Control	C	4	4	1			100
4	INS 3104	Elective 1	E	3	3	1			100
5	INS 3105	Elective 2	E	3	3	1			100
6	INS 3101L	Sensor Technology Lab	C	1			3		50
7	INS 3102L	Control System and Computing Lab	C	1			3		50
Total				20					600

List of Electives

1. Advanced Digital Signal Processing
2. Process Dynamics and Control
3. Advanced Analytical Instruments
4. Optimization Techniques
5. Robotics and Automation
6. Non Linear Control Systems
7. Advanced Biomedical Engineering

Semester II

Sl. No.	Course Code	Course Title	Core / Elective	Credits	Hours/week			CBCS	Marks
					L	T	P		
1	INS 3201	Multi Sensor Data Fusion	C	4	4				100
2	INS 3202	PC Based Instrumentation	C	4	4				100
3	INS 3203	Seminar	C	1			3		50
4	INS 3204	Elective 3	E	3	3	1			100
5	INS 3205	Elective 4	E	3	3	1			100
6	INS 3206	Elective 5	E	3	3	1			100
7	INS 3201L	Soft Computing Lab	C	1			3		50
8	INS 3202L	Advanced Process Control Lab	C	1			3		50
Total				20					650

List of Electives

1. Digital Image Processing
2. Mechatronics
3. MEMS and Microsystems
4. Wireless Sensor Networks
5. Optoelectronics and Instrumentation
6. Non Destructive Testing and Analysis
7. Navigation Guidance and Control
8. Embedded System Design
9. Remote Sensing and Geographical Information Systems
10. Internet of Things

Semester III

Sl. No.	Course Code	Name of the Course	Core / Elective	Credits	Marks
1	INS 3301	Project Progress Evaluation	C	16	500

Semester IV

Sl. No.	Course Code	Course Title	Core / Elective	Credits	Marks
1	INS 3401	Project Dissertation Evaluation	C	16	500

Total credits for the course = 20+20+16+16 = 72

INS 3101 INTELLIGENT TECHNIQUES IN INSTRUMENTATION

Objective:
This course equips the students to understand various aspects of what are called intelligent Instrumentation.

MODULE 1

Introduction to ANNs: Classical AI and Neural Networks, Human brain and the biological neuron, Artificial Neurons, Neural Networks and architectures, feed forward and feedback architectures, geometry of binary threshold neurons and their networks, Supervised and unsupervised learning, concepts of generalization and fault tolerance Supervised learning: Perceptrons and LMS, Back propagation Neural Networks, Fast variants of Back propagation

MODULE 2

Statistical pattern recognition perspective of ANNs: Bayes theorem, Implementing classification decisions with the Bayes theorem, interpreting neuron signals as probabilities, Multilayered networks, error functions, posterior probabilities, error functions for classification problems, Support vector machines, RBFNNs, regularization theory, learning in RBFNNs, Image classification application, PNNs

MODULE 3

Recurrent Neural Networks: Dynamical systems, states, state vectors, state equations, attractors and stability, linear and non linear dynamical systems, Lyupanov stability, Cohen Grossberg theorem, Attractor neural networks: Associative learning, associative memory, Hopfield memory, Simulated annealing and the Boltzmann Machine, BAM, ART principles, Self Organizing Maps.

MODULE 4

Fuzzy Systems: Fuzzy sets, Membership functions, Measures of fuzziness, Fuzzification and defuzzification, Fuzzy relations, Neural Networks and Fuzzy logic, Fuzzy neurons, Fuzzy perceptron, Fuzzy classification networks using Backpropagation, Fuzzy ART

MODULE 5

Genetic algorithms and Evolutionary programming: Genetic algorithms – operators, working, Genetic algorithm based machine learning classifier system. Swarm Intelligent Systems: Ant Colony Systems (ACO): Biological concept, artificial systems - Applications, Particle Swarm Intelligent Systems – PCO method, Applications.

Text Book

1. Neural Networks, A Class room approach, Satish Kumar, Tata McGraw Hill, 2004
2. Artificial Intelligence and Intelligent Systems, N.P Padhy, Oxford University Press, 2005.

References

1. Neural Networks –A Comprehensive Foundation, Simon Haykins, PHI
2. Advanced Methods in Neural Computing, Wasserman P.D, Van Nostrand Reinhold, NewYork.
3. Fuzzy Logic with Engineering Applications, Timothy J. Ross: TMH
4. Fuzzy Logic and Genetic Algorithms, Rajasekharan & Pai Neural Networks, PHI
5. Artificial Intelligence, Elaine Rich, Kevin Knight, Tata McGraw Hill, 2006
6. Fundamentals of Neural Networks- Architectures, Algorithms and Applications- L. Fausett, Pearson Education, 2007.

INS 3102 ADVANCED SENSOR TECHNOLOGY

Objective:

Sensor technology is a field which is an integral part of instrumentation. It is a very wide subject and this course helps the students to learn the latest developments in this field. It will enable them to apply newly introduced techniques to sensor design and fabrication.

MODULE 1

Chemical Sensors: Blood –Gas and Acid –base physiology Electrochemical sensors, Chemical Fibro sensors, Iron-Selective Field-Effect Transistor (ISFET), Immunologically Sensitive Field Effect Transistor (IMFET) , Integrated flow sensor and Blood Glucose sensors.
Optical Sensors: Fiber optic light propagation, Graded index fibers, Fiber optic communication driver circuits, Laser classifications, Driver circuits for solid –state laser diodes, Radiation sensors and Optical combinations.

MODULE 2

Biomedical Sensors: Sensors Terminology in human body, Introduction, Cell, Body Fluids Musculoskeletal system, Bioelectric Amplifiers, Bioelectric Amplifiers for Multiple input Circuits, Differentional Amplifiers, Physiological Pressure and other cardiovascular measurements and devices.

MODULE 3

Electrodes: –Electrodes for Biophysical sensing, Electrode model circuits, Microelectrodes, ECG,EEG,electrodes ECG signals, waveforms, Standard lead system, Polarization Polarizable, Non polarizable electrodes and body surface recording electrodes. Ultrasonic Transducers for Measurement and therapy – radiation detectors – NIR spectroscopy .

MODULE 4

Advanced Sensor Design: Fluoroscopic machines design, Nuclear medical systems, EMI to biomedical sensors, types and sources of EMI, Fields, EMI effects. Computer systems used in Xray and Nuclear Medical equipments. Calibration, Typical faults, Trouble shooting, Maintenance procedure for medical equipments and Design of 2& 4 wire transmitters with 4 – 20 mA output.

MODULE 5

Aerospace Sensor: Laser Gyroscope and accelerometers. Sensors used in space and environmental applications.

Text Book

1. Sensors Hand Book *Sabaree Soloman - Sensors Hand Book*, McGraw Hill,**1998**
2. Smith H.M. - *Principles of Holography*, John Wiley & Sons, New York, 1975
3. J.G. Webster *Medical instrumentation Application and Design,* Houghton Mifilin Co. 2004

References

1. Carr and Brown - *Introduction to Medical Equipment Technology*, Addison Wesley. 1999
2. Culshaw B and Dakin J (Eds) *Optical Fibre Sensors, Vol. 1 & 2 Artech House*, Norwood. (1989)-
3. P. Garnell– *Guided Weapon Control Systems* – Pergamon Press. 1980

INS 3103 ADAPTIVE AND ROBUST CONTROL

Objective:

Control engineering is an indispensable part of instrumentation. In addition to the conventional control methods the students are introduced to the modern developments in the Adaptive and Robust control which will make them up to date in the field.

MODULE 1

System Identification: Introduction, dynamic systems, models, system identification procedure. Simulation and Prediction. Non-parametric time and frequency domain methods. Linear dynamic system Identification: Overview, excitation signals, general model structure, time series models, models with output feedback, models without output feedback. Convergence and consistency.

MODULE 2

Parameter estimation methods, minimizing prediction errors, linear regressions and Least squares method, Instrumental – variable method, prediction error method. Recursive algorithms. Closedloop Identification.

MODULE 3

Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback, pattern recognition, correlation technique.

MODULE 4

Adaptive Smith predictor control: Auto-tuning and self-tuning Smith predictor. Adaptive advanced control: Pole placement control, minimum variance control, generalized predictive control.

MODULE 5

Robust control. Definition and problem statement, the H(n) norm, H∞ norm, frequency domain formulation, state space formulation robust stabilization H2 optimal control, H∞ control.

Text Books

1. Ljung .L, System Identification: Theory for the user, Prentice Hall, Englewood Cliffs.
2. Astrom .K, Adaptive Control, Second Edition, Pearson Education Asia Pte Ltd.

References

1. Chang C. Hong, Tong H. Lee and Weng K. Ho, Adaptive Control, ISA press, Research Triangle Park.
2. Nelles. O, Nonlinear System Identification, Springer Verlag, Berlin.

ELECTIVE (1) ADVANCED DIGITAL SIGNAL PROCESSING

Objective:

The course is a continuation of Digital Signal Processing taught in graduate level. It deals with advanced methods of Digital Signal Processing which enables the student to understand latest DSP design paradigms.

MODULE 1

Review of Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) and Discrete Cosine Transform (DCT). Convolution and Correlation. Time frequency analysis and its need. Short time Fourier Transform.

MODULE 2

Multirate digital signal processing: Basic multirate operations. Efficient structures for decimation and interpolation. Decimation and interpolation and interpolation with polyphase filters. Sampling rate conversion by non-integer factor. Design of practical sampling rate converters. Multirate filtering applications.

MODULE 3

Spectrum Estimation and Analysis: Principles of spectrum estimation. Periodogram method, modified Periodogram methods, the Blackman-Tukey methods, fast correlation method. Autoregressive spectrum estimation: Autoregressive model and filter. Power spectrum density of AR series. Some practical applications.

MODULE 4

Adaptive Filtering: Principles of adaptive filtering. Least mean square (LMS) adaptive algorithm its implementation and limitations. Recursive least square (RLS) adaptive algorithm, its implementation and limitations. Basic Wiener filter theory. Applications of adaptive filters in noise cancellations, echo cancellation.

MODULE 5

Digital Signal Processors: Basic computer architectures for signal processing. General purpose digital signal processors; fixed point digital signal processors and floating point digital signal processors. Implementation of DSP algorithms on general purpose digital signal processors.

Text Books

1. Emmanuel C. Ifeachor and B. W. Jervice, " Digital Signal Processing", Pearson Education, New Delhi.
2. Li Tan, "Digital Signal Processing" Published by Elsevier Inc., New Delhi.

References

1. B. Widrow and S. D Stearns, "Adaptive Signal Processing", Pearson Education, New Delhi.
2. Simon Hykins, "Adaptive Filter Theory", Prentice Hall, New Jersey.

ELECTIVE (2) PROCESS DYNAMICS AND CONTROL

Objective:

This course helps the students to learn additional and advanced techniques regarding process dynamics which was dealt in under graduate level and control methods used for the same.

MODULE 1

Review of Process and Control Systems:
Control Systems, Process control principles, servomechanism, Process control block diagram, identification of elements, Dynamics of liquid process, gas process, flow process, thermal process, mixing process - Batch process and continuous process - Self regulation.

MODULE 2

Design aspects of Process Control System
Classification of variables, Design elements of a control system, control aspects of a process. The input – output model, degrees of freedom and process controllers. Modes of operation of P, PI and PID controllers. Effect of variation of controller variables. Typical control schemes for flow, pressure, temperature and level processes.

MODULE 3

Control System components:
I/P and P/I converters - Pneumatic and electric actuators - valve positioner - control valve Characteristics of control valve - valve body - globe, butterfly, diaphragm ball valves - control valve sizing - Cavitation, flashing in control valves - Response of pneumatic transmission lines and valves. Actuators – Pneumatic, Hydraulic, Electrical/ Electronic.

MODULE 4

Dynamic behavior of feedback controlled process:
Stability considerations. Simple performance criteria, Time integral performance criteria: ISE, IAE, ITAE, Selection of type of feedback controller. Logic of feed forward control, problems in designing feed forward controllers, feedback control, Ratio Control, Cascade Control, Over ride control, auctioneering control, split range control. Processes with large dead time. Dead time compensation. Control of systems with inverse response.

MODULE 5

Introduction to plant wide control:
Plant wide control issues, hypothetical plant for plant wide control issues, internal feedback of material and energy, interaction of plant design and control system design.

Text Books

1. Curtis Johnson, *Process Control Instrumentation Technology* , Prentice Hall of India. 1996
2. George Stephanopoulos, *Chemical Process Control*, Prentice Hall of India. 2005
3. Caughanour and Koppel, *Process systems analysis and control*, Tata McGraw Hill. 1991

References

1. Dale E. Seborg, *Process Dynamics and Control*, John Wiley. 2009
2. Eckman D.P, *Automatic process control*, Wiley Eastern, 1986
3. Patranabis D, *Principles of process control*, Tata McGraw Hill. 2000.

ELECTIVE (3) ADVANCED ANALYTICAL TECHNIQUES

Objective:

Analytical instrumentation is a very important field which requires constant up gradation in learning as newer and newer equipments are introduced frequently. This course covers latest developments in the analytical instrumentation which are used for R&D and production.

MODULE 1

X-ray methods of analysis -Basic principles -Sources -Detectors X-ray absorption methods - X-ray fluorescence technique -X-ray diffraction methods -Electron probe microanalysis.

MODULE 2

Electron and ion Spectroscopy -X-ray and UV photoelectron spectroscopy -ESCA - Electron impact spectroscopy -Auger electron spectroscopy -Ion scattering spectroscopy -Ion scattering spectroscopy -Rutherford back scattering -0 Principles - Instrumentation and analysis.

MODULE 3

Advanced topics in magnetic resonance spectrometry -Fourier transform techniques -Nuclear quadruple resonance spectroscopy -Cl3 NMR- 2nd NMR -Advanced topics in mass spectrometry -Quadruple mass analyser- ESR Spectroscopy - Experimental Techniques, Analysis, Applications.

MODULE 4

Electron microscopy- TEM = SEM -Principles, instrumentation and analysis, Scanning tunneling microscopy, Atomic force microscopy -Principles, instrumentation and analysis -Applications. Photoacoustic and photothermal spectrometers -Principles and instrumentation spectroflourimeters and phosphorimeters -Electrochemical instruments -Conductivity, meters - Coulometers - Amperometers -Radiochemical instruments.

MODULE 5

Flow injection and sequential injection analysis - Biosensor and microchip technology - Microfluidics Lab on Chip - GLMS Instrumentation - HPLC

Text Books

1. Willard, Merrit, Dean and Settle -Instrumental Methods of Analysis -CBS.
2. G. W. Ewing- Instrumental methods of chemical analysis -McGraw Hill.

References

1. A. Skoog and M. West -Principles of Instrumental analysis -Hall Sanders International
2. R.S. Khandpur -Handbook of Analytical instruments - Tata McGraw Hill.
3. Jack Cazes - Analytical Instrumentation Handbook, Third Edition November 30, 2004 by CRC Press ISBN 9780824753481

ELECTIVE (4) OPTIMIZATION TECHNIQUES

Objective:

The course offers students opportunity to learn various optimization techniques used in Engineering applications.

MODULE 1

Introduction to optimization, functions of single variable, functions of several variables, formulation of optimization problems. Review of classical methods, linear programming, nonlinear programming.

MODULE 2

Constraint optimality criteria, constrained optimization, constraint direct search method, linearization methods for constrained problems, transformation method. Nonlinear programming: problem formulation, Quadratic Approximation Methods for Constrained Problems Unconstrained minimization techniques.

MODULE 3

Dynamic programming: sub-optimization, multistage optimization problem. Multi-objective and goal programming: problem formulation, solution of a multi-objective problem. Case studies

MODULE 4

Introduction to Stochastic Optimization Techniques, types: Local Search, Population Based, Introduction to Genetic Algorithms, Motivation from Nature, Genetic Algorithms: Working Principle: Representation, Fitness Assignment, Reproduction, Crossover, Mutation, Constraint Handling, Real Parameter Genetic Algorithms, Combined Genetic Algorithm, Advanced Genetic Algorithms, Applications.

MODULE 5

Ant Colony Optimization: Introduction, Ant System, Ant Colopny System, ANTS, Significant Problems, Convergence Proofs. Discrete Particle Swarm Optimization (PSO): Introduction, PSO Elements: Position and State Space, Objective Function, Velocity, PSO Algorithm, Examples and Results, Applications.

Text Books

1. Singiresu S. Rao, ‘Optimization Techniques’, New Age International Publishers.
2. D. P. Kothari and J. S. Dhillon, ‘Power System Optimization, Tata McGraw Hill.

References

1. C. Mohan and Kusum Deep, ‘Optimization Techniques, New Age International Publishers.
2. Godfrey C. Onwubolu, B. V. Babu, “New Optimization Techniques in Engineering”, Springer-Verlag.
3. Marco Dorigo, Thomas Stützle, “Ant colony optimization”, MIT Press.

ELECTIVE (5) ROBOTICS AND AUTOMATION

Objective:

This is one of the fast-growing branches of engineering with very wide applications like routine manufacturing lines, space exploration, deep sea exploration, medical field, war fare etc. It is a multidisciplinary field. This course helps the students to get introduced to this field as well as learn some advanced techniques used in the automation using robots.

MODULE 1

Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

MODULE 2

Power Sources and Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

MODULE 3

Manipulators, Actuators and Grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

MODULE 4

Kinematics and Path Planning: Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages.

MODULE 5

Case Studies: Multiple robots – machine interface – robots in manufacturing and nonmanufacturing applications – robot cell design – selection of robot.

Text Books

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G *Industrial Robotics*, McGraw-Hill Singapore. 1996
2. Ghosh *Control in Robotics and Automation: Sensor Based Integ*ration, Allied Publishers, Chennai.1998

References

1. Deb.S.R- *Robotics technology and flexible Automation*, John Wiley, USA. 1992
2. Klafter R.D., Chimielewski T.A., Negin M *Robotic Engineering – An integrated approach,* Prentice Hall of India, New Delhi. 1994
3. Mc Kerrow P.J. *Introduction to Robotics,* Addison Wesley, USA. 1991

ELECTIVE (6) NONLINEAR CONTROL SYSTEMS

Objective:

The course helps the students to learn about the non-linear types of control systems which are needed in several applications.

MODULE 1

Introduction: Nonlinear system behaviour, concepts of phase plane analysis, singular points, constructing phase portraits, phase plane analysis of non linear systems, existence of limit cycles, concepts of stability, describing function analysis – assumptions and definitions, describing functions of common nonlinearities.

MODULE 2

Lyapunov theory: Lyapunov direct method, positive definite functions and lyapunov functions, invariant set theorems, lyapunov analysis of linear time invariant systems, the variable gradient method, performance analysis, control design based on lyapunov's direct method, Lyapunov analysis of non autonomous systems, existence of Lyapunov functions.

MODULE 3

Feedback Linearization: Feedback linearization and the canonical form, Input – state linearization, input – output linearization of SISO and MIMO systems.

MODULE 4

Sliding Control: Sliding surfaces, continuous approximations of switching control laws, modeling performance trade offs, VSSC – examples.

MODULE 5

Control of multi input physical systems: Adaptive robot trajectory control, spacecraft control, attitude control.

Text Book

1. R. Marino and P. Tomei *Nonlinear control design - Geometric, Adaptive and Robust*,Prentice Hall,1995

References

1. J.J.E.Slotine and W.Li *Applied Nonlinear control*, Prentice Hall, 1998
2. Alberto Isidori *Non linear Control systems*, Springer Verlag, , 1999

ELECTIVE (7) ADVANCED BIOMEDICAL ENGINEERING

Objective:

Advanced topics in bio medical engineering are covered in the course. It is a continuation of the graduate level course.

MODULE 1

Development of Biomedical Instrumentation, biometrics, Man-instrument system-components-block diagram, Physiological systems of the body (brief discussion), Problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials –propagation of action potentials bioelectric potentials- examples (ECG, EEG, EMG, ERG, EOG, EGG, etc.) Biopotential electrodes–theory-microelectrodes- skin surface electrodes- needle electrodes biochemical transducers-transducers for biomedical applications.

MODULE 2

Heart-Iung machine -Artificial heart valves -Pacemakers and Defibrillators - Anaesthesia machine -0 .Blood cell counter -digital thermometer -Audiometer - Electron Microscope -up based ventilator biomaterials.

X-ray machine -Radiography, fluoroscopy -image intensifiers -Conventional X-ray Imaging - Angiography -Computed tomography -linear tomography -tomography scanner- applications. Magnetic Resonance Imaging systems -Basic NMR components.

MODULE 3

Ultrasonic imaging systems -Physics of ultrasonic waves, medical ultrasound. construction of an ultrasonic transducer. different modes of operations of ultrasound -A scan, B scan - Echocardiograph (M mode), Real time ultrasonic imaging system, Computer controlled ultrasonic imaging -Applications.

MODULE 4

Laser application in machine -Laser- Pulsed Ruby Laser, Nd- AG laser, Argon Laser, C02 laser, Helium-neon laser -applications -Advantages of laser surgery -Laser based Doppler blood flow meter-Endoscope -Cardio scope -Laproscope -Endoscopic laser coagulator cryogenic surgery. Medical thermography- Physics of themography.

MODULE 5

Medical thermography -Physics of theromography -Them1ographic equipment Quantitative medical thermography -Infrared, Liquid crystal and Microwave Thermography- Medical applications of thermography. Computer applications in Medicine - Computer aided ECG analysis-Computerized Catheterisation Laboratory -Computerised Patient monitoring system..

Text Books

1. Leslie Cromwel -Biomedical instrumentation and measurements -Prentice Hall.
2. L.A. Geddes and L.E. Baker -Principles of Applied biomedical instrumentation -John Wiley and sons.

References

1. B. Jacobson and J.G. Webster -Medicine and Clinical Engineering -Prentice Hall of. India
2. Macka Sturat Biomedical telemetering- John Wiley.
3. R.S. Khandpur -Handbook of biomedical engineering -Tata McGraw Hill.

INS 3201 MULTISENSOR DATA FUSION

Objective:

The course covers an important aspect of data collection and utilization. Multi sensor data fusion is one of the most useful techniques in practical applications. Understanding of this is of immense use to the student in most of his sensor related work environments.

MODULE 1: Introduction

Sensors and sensor data, Use of multiple sensors, Fusion applications. The inference hierarchy: output data. Data fusion model. Architectural concepts and issues. Benefits of data fusion, Mathematical tools used: Algorithms, co-ordinate transformations, rigid body motion. Dependability and Markov chains, Meta – heuristics.

MODULE 2 Algorithms for Data Fusion

Taxonomy of algorithms for multisensor data fusion. Data association. Identity declaration.

MODULE 3: Estimation

Kalman filtering, practical aspects of Kalman filtering, extended Kalmal filters. Decision level identify fusion. Knowledge based approaches.

MODULE 4: Advanced Filtering

Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion.

MODULE 5: High Performance Data Structures

Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures. Designing optimal sensor systems with in dependability bounds. Implementing data fusion system.

Text Books

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston.
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey.

References

1. Arthur Gelb, Applied Optimal Estimation, M.I.T. Press.
2. James V. Candy, Signal Processing: The Model Based Approach, McGraw –Hill Book Company.
3. Jitendra R Raol, Multi - Sensor Data Fusion with MATLAB , CRC Press, New York.

INS 3202 PC BASED INSTRUMENTATION

Objective:
This Course is a continuation of graduate level course. It offers a better and deep exposure of the subject to students.

MODULE 1
Introduction to LabVIEW: Software environment, front panel, block diagram, palettes, loops, structures and tunnels, arrays, clusters, plotting data**.**
Modular Programming: Modular programming in LabVIEW, creating an icon, building a connector pane, displaying sub VIs and express Vis as icons or expandable nodes, creating subVIs from sections of VIs, opening and editing sub VIs, placing sub VIs on block diagrams, creating stand alone applications.

MODULE 2
Strings and File I/O: creating string controls and indicators, string functions, editing, formatting and parsing strings, configuring string controls and indicators, basics of file input/output, file I/O VIs.
Instrument Control: GPIB communication, hardware and software architecture and specifications, instrument I/O assistant, VISA, Instrument Drivers, Serial Port communications.

MODULE 3
Data Acquisition: Transducers, signal conditioning, DAQ hardware configuration, DAQ hardware, Analogy I/O, Counters, Digital I/O, DAQ assistant, selecting and configuring a data acquisition device.
IMAQ Vision: Vision basics, image processing and analysis, particle analysis, machine vision, machine vision hardware and software, building a complete machine vision system.

MODULE 4
Introduction to Communication Protocols: Data Communication basics, OSI reference model, Network Classification, Device Networks, Control Networks, Enterprise Networks.
Networks in Process Automation: Introduction to Networks in process automation, Information flow requirements, Industry Networks, Network selection.
Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols: RS-232, RS- 422, RS-485, Ethernet, Modbus, Profibus, Fieldbus; Hardware: Fieldbus Design, Advantages and Limitations.

MODULE 5
Introduction to wireless Protocols : WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave, IRIB-B.
Communication Protocols for Power System: Communication requirements for power system automation, Protocols used, Need for Interoperable Communication, Overview of IEC 61850 Standard: Data Models, Communication Services, GOOSE Communication: Implementation and its advantages.

Text Books

1. Jerome, PHI *Virtual Instrumentation using LabVIEW,* Jovitha, ISBN 978-81-203- 40305, 2010.
2. Gary Johnson - Labview *Graphical Programming*, Second edition, McGraw Hill. 1997

References

1. B.G. Liptak, '*Process Software and Digital Network"*, CRC Press ISA- The Instrumentation, Systems, and Automation Society.
2. User Manuals of Foundation Fieldbus, Profibus, Modbus, Ethernet, Devicenet, Controlnet, IEC 61850.
3. Peterson Davie, "Computer Networks—A System Approach", Maugann Kauffmann Publisher.

INS 3203 SEMINAR

All the students of II semester will be required to deliver a seminar on the topic relevant to recent trends in “Control and Instrumentation Systems” using power point presentation. Topics are selected in consultation with their supervisors. Presentation will be of 15 minutes duration followed by a question answer session at least two times in a semester before the duly constituted committee of the Faculty Members of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the seminar in the form of hard copy must also be submitted in the office before the final evaluation by External Examiners.

ELECTIVE (1) Digital Image processing

Objective:

A very essential course which forms the basis of Machine vision and related fields. The course equips the students to deal with practical applications of digital image processing.

MODULE 1

Digital Image fundamentals: representation, elements of visual perception, simple image formation model, image sampling and quantization, basic relationship between pixels, imaging geometry.
Review of Matrix theory results: Row and Column ordering, Doubly Block Toeplitz for 2 D linear convolution, Doubly Block Circulant Matrices for circular convolution, Kronecker products, Unitary and orthogonal matrices.
Unitary Transforms for Image processing: General Unitary Transforms, DFT, DCT, DST, Hadamard Transform, Haar Transform, , Karhunen Loeve Transform.

MODULE 2

Image Enhancement: Spatial Domain Methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging. Spatial filtering- smoothing filters, sharpening filters, Frequency Domain methods- low pass filtering, high pass filtering, homomorphic filtering, generation of spatial masks from frequency domain specifications

MODULE 3

Image restoration: Degradation model, Diagonalization of circulant and doubly block circulant matrices, Algebraic approaches- Inverse filtering, Wiener filtering, Constrained Least Squares restoration, Interactive restoration, Geometric transformations.

MODULE 4

Image Compression: Fundamentals, redundancy: coding, interpixel, psychovisual, fidelity criteria, Models, Elements of information theory, error free compression - variable length, bit plane, lossless predictive, lossy compression- lossy predictive, transform coding, Fundamentals of JPEG image compression, Wavelet based compression techniques- EZW, SPIHT, JPEG 2000.

MODULE 5

Image Segmentation: Detection of discontinuities- point, line, edge and combined detection, edge linking and boundary description, local and global processing using Hough Transform- Thresholding, Region oriented segmentation – basic formulation, region growing by pixel aggregation, region splitting and merging, use of motion in segmentation.
Color Image Processing: color models- RGB, CMY, YIQ, HIS, Pseudo coloring, intensity slicing, gray level to color transformation.

Text Book

1. Digital Image Processing- Gonzalez and Woods, Pearson education, 2002.
2. Fundamentals of Digital Image Processing – A K Jain, Pearson education, 2003.

References

1. Digital Image Processing- W K Pratt, John Wiley, 2004
2. Digital Signal and Image Processing- Tamal Bose, John Wiley publishers.
3. Two dimensional signal and Image Processing- J S Lim, Prentice Hall.

ELECTIVE (2) Mechatronics

Objective:

A fusion of mechanical and electronics field it is a very practically oriented discipline useful in most of the engineering applications. This paper deals with the fundamentals as well as design aspects.

MODULE 1

Introduction: definition, trends, control systems, micro-controller based controllers, PC based controllers.

MODULE 2

Design of sensor and signal conditioning for Displacement, position, velocity, force, pressure, temperature.

MODULE 3

Precision mechanical actuation: Pneumatic, Electro-pneumatic, Hydraulic, Electro-hydraulic actuation systems, ball screw and nut, linear motion guides, linear bearings, bearings, harmonic transmission, motor/drive selection.

MODULE 4

Electro mechanical drives: relays and solenoid, stepper motors, DC-brushed / brushless motors, DC servo motors, breaking methods, PWM, Bi-polar driver, MOSFET drivers, SCR drivers, Variable Frequency Drives.

MODULE 5

Micro-controller and interfacing: Digital signal interfacing techniques, Analog signal interfacing with ADC and DAC. Programmable logic and motion controller: programming, interfacing of sensors and actuators to PLC, Simultaneous control of axes integration of axes and I/Os.

Text Book

1. Devid G. Alciatore, Michael B. Histand , ‘Introduction to Mechatronics and measurement systems’, 2nd Edition, McGraw-Hill.

References

1. Bella G Liptak, ‘Instrument Engineer’ Handbook, Vol. 1, 2 and 3, CRC Press.
2. Ajay V. Deshmukh, ‘Microcontrollers’, 1st edition, Tata McGraw-Hill.

ELECTIVE (3) MEMS and Microsystems

Objective:

Micro electro mechanical systems is a technology that combines computers with tiny mechanical devices such as sensors, actuators etc embedded in semiconductor chips. It is one of the latest fields which is hotly pursued in the research labs as well as industry. The course offers a good foundation to the students.

MODULE 1

Introduction, Planar Vs 3d structures, Microsystem sensors, actuators and fluidics overview, Basics of micro system engineering- doppig, diffusion, plasma physics, electrochemistry.

MODULE 2

Engineering mechanics of microsystem, Stating bending of thin plates, mechanical vibration, thermos mechanics, fracture mechanics, thin film mechanics, basics of finite element stress analysis

MODULE 3

Materials for MEMS- substrate and wafers, silicon, properties, silicon compounds, Silicon piezo resistors, gallium arsenide, Quartz, piezoelectric crystals, Polymers, Packaging materials.

MODULE 4

Microsystem fabrication processes- Photolithography, Ion implantation, diffusion, oxidation, CVD, PVD, Epitaxy, Physical and chemical etching, Micromanufacturing- bulk micromanufacturing, surface micromachining, LIGA process, micro system packaging

MODULE 5

RF MEMS- Basic ideas, Micromachined switches, antennas, inductors, capacitors, BioMEMS- Multi-parameter BioMems for clinical monitoring, neural implants, microfluidic platforms, DNA based systems.

Text Books

1. Fundamentals of Microfabrication, Madou, CRC Press
2. MEMS and Microsystems, Tai-RanHsu, McGraw-Hill

References

1. RF MEMS, Theory, Design and Techology, Gabriel M. Rebeiz, Wiley
2. BioMEMS, Gerald A. Urban, Springer

ELECTIVE (4) WIRELESS SENSOR NETWORKS

Objective:

It is a modification on the traditional data collection using sensors. Wireless sensors are of much more convenience in several applications and the course helps the students to understand the advanced techniques of this field.

MODULE 1: Introduction

Introduction and overview of Wireless Sensor Networks (WSN), Commercial and Scientific Applications of WSN, Category of Applications of WSN, Challenges for WSN, Enabling Technologies for WSN.

MODULE 2 : Architecture

Single node Architecture: Hardware Components, Energy Consumption of Sensor nodes, Operating Systems and Execution Environments, Examples of Sensor Nodes, Network Architecture: WSN Scenarios, Optimization Goals and figures of Merits, Design principles for WSNs, Service Interfaces for WSNs, Gateway Concepts.

MODULE 3: Protocols

Physical Layer: Wireless Channel and Communication Fundamentals, Physical Layer & Transceiver Design Considerations in WSN, MAC Protocols: Fundamentals, MAC Protocols for WSNs, IEEE802.15.4 MAC Protocol, - IEEE 1451, A Universal Transducer Protocol Standard- Routing Protocols: Gossip and agent based unicast protocols, Energy Efficient Unicast, Broadcast and Multicast, Geographic Routing, Transport Control Protocols: Traditional Protocols, Design Issues, Examples of Transport Protocols, Performance of Transport Control Protocols.

MODULE 4: Information Processing

Sensor Tasking and Control: Information-Based Sensor Tasking, Joint Routing Information Aggregation, Sensor Network Databases: Challenges, Query Interfaces, In-Network Aggregation, Data Centric Storage, Data Indices and Range queries, Distributed Hierarchical Aggregation, Temporal Data.

MODULE 5: Platform & Tools

Operating Systems for Sensor Networks: Introduction, Design Issues, Examples of Operating Systems, Node Level Simulators, Performance and Traffic Management Issues: WSN Design Issues, Performance Modelling of WSNs, Emerging Applications and Future Research Directions.

Text Books

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks: Technology, Protocols, and Applications”, John wiley & Sons.
2. Holger Karl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, John wiley & Sons.

References

1. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks; An Information Processing Approach”, Elsevier.
2. C. S. Raghavendra, Krishna M. Shivalingam, Taieb Znati, “Wireless sensor networks”, Springer Verlag.
3. H. Edgar, Jr. Callaway, “Wireless Sensor networks, Architectures and Protocols”, CRC Press.

ELECTIVE (5) OPTOELECTRONICS AND INSTRUMENTATION

Objective:
The course equips the students to understand various opto- electronic devices

MODULE 1
Interferometers – Faby-Perot, Michelson interferometer, Interference filters, Optical spectrum analyzer, Modulation of light, electro-optic, magneto-optic and acousto-optic

MODULE 2

Lasers- Principle of operation, Einstein relations, Population inversion, optical feedback, resonant cavity, laser modes, Q-switching, mode locking, 3 and 4 level systems, properties of lasers.

MODULE 3

Classes of lasers- Solid state, gas lasers and dye lasers, operation and working, semiconductor lasers, Applications, holography, industrial biomedical , pollution monitoring

MODULE 4

Optical fiber- Light guidance through fibers, step index fiber, graded index fiber, multi mode, single mode, numerical aperture, dispersion, loses in fiber, measurement fiber characteristics, OTDR, couplers, splicers, connectors.

MODULE 5

Optical fiber communication system, components, modulation, demodulation, fiber optic sensors, pressure, temperature displacement acceleration strain, fiber bragg grating, photonic band gap materials.

Text Books

1. J. Wilson and J.F Hawkes, Optoelectronics-An introduction, Pentice Hall
2. K. Tyagarajan and A.K.Ghatak, Lasers- Theory and Applications, Springer

References

1. T. Ray, Optoelectronics and Fiber Optics Technology,
2. R. Kashyap, Fiber Bragg Grating Academic Press

ELECTIVE (6) NON-DESTRUCTIVE TESTING AND ANALYSIS

Objective:
It is a very important aspect of material testing and has wide applications in industry. The course gives a firm foundation to students in this area.

MODULE 1
Introduction - Acoustic Emissions- Principles and Theory. Signal Propagation. The AE Process Chain, The AE Measurement Chain, Physical Considerations. Time Considerations. AE Parameters. AE Theory, AE Transducers, Acoustic Emission Sensors and Couplers, AE Sensor Construction. Acoustic Emission Technology, , Applications. Advanced Equipment.

MODULE 2
Electromagnetic Testing Method, Eddy Current Sensing Probes, Flux Leakage Sensing Probes, Alternating Current Field Measurement (ACFM) Method, Calibration and Testing, Laser Testing methods- Profilometry Methods, Holography, Interferometry. Confocal Measurement, Scanning Laser Profilometry, Optical Inspection Systems, Visual and optical testing.

MODULE 3
Leak Testing Methods- Ultrasonic Leak Testing. Bubble Leak Testing. Dye Penetrant Leak Testing, Pressure Change Leak Testing, Mass Spectrometer Leak Testing, "Sniffer" Techniques, Liquid Penetrant Tests, Magnetic Particle Testing.

MODULE 4
Neutron Radiographic Testing, Radiographic Testing Method, Industrial Radiography, Portable Linear Accelerators, Fluoroscopy Techniques. Thermal/Infrared Testing Method, Heat and Light Concepts. Color Change Thermometry Infrared Imaging Systems.

MODULE 5
Ultrasonic Testing - Noncontacting Ultrasonic Testing, Ultrasonic Pulsers/Receivers, Multilayer Ultrasonic Thickness Gauge. Time-of-Flight Diffraction, **Vibration Analysis Method,** Principles/Theory. Stress Analysis, Vibration Analysis/Troubleshooting, Impact Testing and Frequency Response, Machine Diagnosis

Text Book

1. Introduction to Nondestructive Testing: A Training Guide, 2nd Edition, Paul E. Mix, Wiley, 2005

References

1. Practical Non-destructive Testing, Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing, 2002.
2. Nondestructive Testing of Deep Foundations - Bernard Hertlein , Allen Davis, 2006, Publisher John Wiley and Sons Ltd
3. Theory and Practice of Infrared Technology for Nondestructive Testing - Xavier P. V. Maldague, 2001 , Publisher John Wiley & Sons Inc
4. NDT Data Fusion - Xavier Gros, Publisher ELSEVIER SCIENCE & TECHNOLOGY

ELECTIVE (7) NAVIGATION GUIDANCE AND CONTROL

Objective:

The course teaches the students various aspects of navigation, guidance and control which is of tremendous importance in the control of terrestrial, aerospace and underwater vehicles.

MODULE 1

Modeling and dynamics of Aircraft: Longitudinal dynamics –displacement autopilot- pitch rate feedback for damping- control stick steering acceleration control system – Glide slope control system. Lateral dynamics of an Aircraft, Yaw damper- Method of obtaining coordination- beta feedback-beta beta dot feedback – acceleration feedback. Yaw orientational control system- Roll angle control system - Landing.

MODULE 2

Dynamics of Aerospace vehicles: Missiles Missile Control Systems; Dynamics and Control of Rigid and Elastic Rockets; Control-Structure Interaction; Longitudinal and Lateral Autopilots for Rigid Aircraft;

MODULE 3

Navigation: Terrestrial navigation, Celestial navigation, Terrestrial radio navigation, satellite based navigation, inertial navigation, Integrated Navigation.

MODULE 4

Guidance: Introduction to Guidance, Navigation and Avionics; Radar Systems, Command and Homing Guidance Systems. Mission consideration and analysis of flight path, Optimal guidance Laws, Inertial Guidance

MODULE 5

Control of Aerospace Vehicles: Design of Controllers for Aerospace Vehicles; Classical, Pole assignment, Eigen Structure Assignment, Optimal Control, LQR, LQG/LTR, Observers and Kalman Filters

Text Books

1. Garnell, P. *Guided Weapon Control Systems, Peraganon*. 1980.
2. Blakelock, J H. *Automatic Control of Aircraft and Missiles*, John Wiley. 1991
3. Greensite A L, *Analysis and Design of Space Vehicle Flight Control System*, Spartan Books. 1970

References

1. Skolnik R E. *Introduction to Radar System*, Mc Graw Hill. 1982
2. D'Azzo J J and Hougis, C H, *Linear Control System Analysis and Design*, (4*e*) Mc Graw Hill,.
3. D. S. Naidu, *Optimal Control Systems*, 1/e, CRC Press. 2003
4. B. Hofmann-Wellenhof, K. Legat, M. Wieser, *Navigation Principles of Positioning and Guidance*. Springer Wien New York. 2003.

ELECTIVE (8) EMBEDDED SYSTEM DESIGN

Objective:

The course gives a good foundation to the understanding of the field

MODULE 1

Introduction to embedded systems: Categories of embedded systems, overview of embedded system architecture, Microcontroller programming and structured design, Factors to be considered in selecting a microcontroller, recent trends in embedded systems.

MODULE 2

Custom Single purpose Processor: RT level combinational components, RT level sequential components. Custom single purpose processor design; RT level Custom single purpose processor design, General purpose processor: basic architecture, data path, control MODULE.

MODULE 3

Real Time Operating System (RTOS) based Embedded System Design: Operating system basics, Types of operating systems, Tasks, process and threads, Multiprocessing and Multitasking, Task scheduling, Threads, processes and scheduling: putting them altogether, Task communication, Task synchronization, Device Drivers, How to choose an RTOS.

MODULE 4

Overview of 8051 microcontrollers. Designing with 8051, why 8051 microcontroller, Programming with 8051 microcontroller, different addressing modes supported by 8051 microcontroller., The 8051 instruction sets. Some examples of System design using 8051/8052 microcontroller.

MODULE 5

Introduction to AVR family of microcontrollers, Introduction to AtXmega 128A1 Microcontroller, AVR CPU, EBI- external bus interference, DMAC, system clock and clock option, Power management, Programmable multilevel interrupt controller, I/O ports, instruction set. Design examples using AtXmega128A1.

Text Book

1. “Embedded System Design- A Unified Hardware/ Software Introduction”, Frank Vahid and Tony Givar gis, John Wiley & Sons.
2. “Introduction to Embedded Systems”, Shibu K V, Tata McGraw Hill.

References

1. “The 8051 Microcontroller and Embedded systems”, Mazidi M L, Mazidi J G, Mckinlay R D, Pearson Education Inc, New Delhi.
2. “Embedded C Programming and the Atmel AVR”, Barnett R, O’Cull L, Cox S, Thomson Delmar Learning, Canada.
3. “X-Mega- A Manual”- Atmel Corporation.

ELECTIVE (9) REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS

Objective:

It is one of the most important areas of interest to agriculture, mining, forestry, climate prediction etc.

The course gives a good exposure to students regarding this field.

MODULE 1

Remote Sensing

Aerial photography and photogrammetry: basic principles, photographic systems, visual interpretation and mapping. Ground truth verification radiometer and its application.

Basic concepts of remote sensing: Idealized remote sensing system. Physics of remote sensing, electromagnetic spectrum, black body concept, atmospheric windows, geometry of scanners, CCD arrays and platforms, history of space imaging characteristics of space platform like LANDSAT, SPOT, IRS, etc. Characteristics of sensors like MSS, TM, LISS I and LISS II. Outputs from various sensors.

MODULE 2

Classification of digital data and information:

Supervised, unsupervised. Extractionprocedure for different applications and terrain evaluation. Thematic interpretation, transfer of interpreted thematic information to base map. Ground verification.

Application of remote sensing: Civil Engineering, Earth Science, Forestry, Agriculture, Oceanography, Fisheries, Water resources, Town planning and land use/land cover mapping.

MODULE 3

Geographic Information System

Introduction: Map and use of maps through time, thematic and multiple theme maps, Development of GIS as an introduction and decision making system

An Overview of GIS: Definition, Objectives and basic concepts, Contributing disciplines and technologies.

MODULE 4

Digital Representation of Geographic Data: Technical issues related to digital representation of geographic data, Data quality and standards, Assessment of data quality, Managing spatial errors, Data standards and GIS development.

Components of GIS: Computer hardware, peripherals and software

MODULE 5

Integration of Remote Sensing and GIS: Extracting metric information from Remotely Sensed images, Extracting thematic information from Remotely Sensed images, Integration of information from remote sensing in GIS . GIS application areas.

Text Books

1. Paul R Wolf , *Elements of photogrammetry* –- Mc Graw-Hill
2. Lille sand & Kiefer, *Remote sensing and image interpretation*, John Wiley and Sons
3. Floyd F. Sabins *Remote sensing principles and interpretation* - - WH Freeman & Co.

References

1. John R Jensen, *Introductory digital image processing* - - Prentice Hall
2. George Joseph, *Fundamentals of Remote Sensing*- -Universities Press-Technical
3. L R A Narayan *Remote Sensing and its Applications*- - Universities Press-Science/Reference
4. M. Anji Reddy, *Remote Sensing and Geographic information systems* – BS Publishers.

ELECTIVE (10) INTERNET OF THINGS

Objective:
A new and emerging area, it is getting more and important in several important fields of activity. The course is structured in a way to impart students with basics of this field.

MODULE 1:Technologies involved in IOT Development:
Internet/Web and Networking Basics: OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, Introduction to Cloud Computing
IOT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.
Network Fundamentals: Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's – Access Points, Hubs etc. Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions.

MODULE 2: IOT Architecture:
History of IOT, M2M – Machine to Machine, Web of Things, IOT protocols - M2M Area Network Physical Layers - IEEE 802.15.4 - The IEEE 802 Committee Family of Protocols - The Physical Layer - The Media-Access Control Layer - Uses of 802.15.4 - The Future of 802.15.4: 802.15.4e and 802.15.4g
Applications: Remote Monitoring & Sensing, Remote Controlling,Performance Analysis
The Architecture: The Layering concepts , IOT Communication Pattern, IOT protocol Architecture, The 6LoWPAN Security aspects in IOT

MODULE 3: IOT Application Development:
Application Protocols: MQTT, REST/HTTP, CoAP, MySQL
Back-end Application Designing: Apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB Object type Database, HTML, CSS & jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development, Application Development for mobile Platforms: Overview of Android / IOS App Development tools

MODULE 4: Case Study & advanced IOT Applications:
IOT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IOT electronic equipments. Use of Big Data and Visualization in IOT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

MODULE 5: Key Applications of The Internet of Things
Real World Design Constraints - Smart Metering Advanced Metering Infrastructure - e-Health Body Area Networks - City Automation - Automotive Applications - Home Automation - Smart Cards - Tracking (Following and Monitoring Mobile Objects) - Over-The-Air-Passive Surveillance Ring of Steel - Control Application Examples - Industrial Automation- Smart Cities

Text Books

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
3. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann

References

1. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
2. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
3. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
4. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
5. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
6. Designing The Internet of Things : Adrian Mcewen, Hakin Cassimally , Wiley-India, 2013
7. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
8. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.
9. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

INS 3101L SENSOR TECHNOLOGYLAB

There are around 8-10 experiments to be conducted by the students covering almost all MODULEs of theory course. The experiments include response characteristics of thermistor, current measurement using Hall effect transducer, controller using optical transducer (LDR), response characteristics and coefficients of RTD, phase detection electronics circuit for capacitive transducer with 7556 dual timer, active bridge circuit, active low and high pass filter, LABVIEW® and DAQ card for LVDT transducer, pressure measurement at remote location using RFID activated transducer.

Also, it is expected that the students must learn to use the latest equipment and software so that the Industry gets trained Engineers.

INS 3102L CONTROL SYSTEM AND COMPUTING LABORATORY

8 -10 Experiments

1. Familiarization with Matlab and Matlab Control System Toolbox.
2. Transfer functions
3. Time domain analysis and steady state errors
4. Proportional Integral Derivative Control
5. Stability analysis using Bode plots and Nyquist plots
6. State Space analysis - Controllability, Observability and system gain
7. Pole placement and Root locus
8. Compensation design using Lag, Lead compensators
9. Compensators using Lead – Lag approaches
10. Models of Practical systems like electric Power System
11. Familiarization of digital Control System Analysis
12. Analysis of stability in digital domain.

Text Book

1. D. Frederick and J. Chow, *Feedback control problems using MATLAB*, Brooks/Cole Thomson Learning, 2000

References

1. MATLAB documentation.
2. Control System Tool Box documentation

INS 3201L SOFT COMPUTING LAB

The following experiments are to be tested using MATLAB toolboxes although programming language is suggested as a better option:

I. MATLAB Fuzzy Logic Toolbox

1. To implement fuzzy set operations
2. To implement fuzzy relational operations.
3. To design and implement fuzzy temperature controller
4. To design and implement Fuzzy Traffic light controller
5. To write and illustrate the concept of Fuzzy C – means Clustering
6. To design a self-executable fuzzy logic controller

II. MATLAB Neural Network Toolbox

1. Write programs to test the learning rules of Hebb, Perceptron, Delta, and Widrow Hoff in MATLAB
2. Learning rule to implement the Back-propagation algorithm
3. To write and test a program for the linear separability of the input domain
4. To write and implement a Hopfield algorithm.
5. To write a program for pattern recognition
6. To design a self-executable neural classifier.

Text Book

1. S.N. Sivanandam, S. Sumathi, S.N. Deepa *Introduction to Neural Networks using Mat Lab* - Tata Mc Graw Hill 2006

Reference

1. Jyh Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani - *"Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning",* Prentice Hall. 1997
2. Chin –Teng Lin and C.S. George Lee - "*Neural Fuzzy Systems" – A neuro fuzzy synergism to intelligent systems* Prentice Hall International. 1996
3. Yanqing Zhang and Abraham Kandel - *"Compensatory Genetic Fuzzy Neural Networks and Their Applications"* World Scientific. 1998

INS 3202L ADVANCE PROCESS CONTROL LAB

8 -10 Experiments from Both Cycles (4-5 from each)

I Cycle:

1. Design and simulation of PID controller for Temperature process station.
2. To acquire and display a continuously changing physical variable in the system using Lab View/Matlab/ Custom software.
3. Program to implement online data processing and data logging.
4. Experimentation of a Multi process Trainer.
5. To implement discrete control strategy using both analog and digital Siemens PLC.
6. To study on the interface of PLC with PC for data acquisition applications.
7. To develop stand alone executable signal conditioning files as library files in Lab View/Matlab.
8. Experimentation of Control loops for Inverted Pendulum.
9. Implementation of Digital PID Controller.
10. Signal Conditioning Circuit for Temperature Measurement.
11. System Identification by the Method of Approximation.
12. Controller tuning by Frequency domain analysis.

II Cycle:

1. To analyse the stability of a level control system with time delay in frequency domain analysis.
2. To auto tune a PID controller using a relay switch method for process control systems
3. To study the phenomenon of the reset windup and to compensate it with anti reset windup technique for a first order process.
4. To analyse the stability of the discrete control system and to compare it with the continuous control system using IMC.
5. To study the robustness of the simple first order time delay process with frequency response analysis.
6. Design and simulation of split range controller.
7. Computer calibration of temperature and pressure measuring instruments
8. Design and simulation of cascade controller.
9. Experimental Study of DCS and SCADA in a process control system.
10. To study the action of ON/OFF, P, PI, PID control for pressure process station.
11. Stability analysis of process control systems.
12. Study of performance and automation of a flexible manufacturing trainer.

Text Book

1. Curtis D. Johnson –*Microprocessors in Process Control*, PHI. 1993

Reference

1. George Stephanopoulos *Chemical Process Control.* 2005
2. Coughner *Process Analysis & Control*, Tata Mcgraw Hill. – 1991

INS 3301 PROJECT PROGRESS EVALUATION

The Project is aimed at training the students to analyze any problem in the field of Instrumentation systems independently. The project may be analytical, computational and experimental or combination of them based on the latest developments in the relevant areas. It should consist of objectives of study, scope of work, critical literature review and preliminary work done pertaining to the seminar undertaken in Semester II.

During the project period, every student has to present the progress of their works before the duly constituted committee of internal teachers of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the project in the form of hard copy must be submitted in the office before the final evaluation by the External Examiners.

INS 3401 PROJECT DISSERTATION EVALUATION

Dissertation is a continuation of the project work done by the student during Semester III. The dissertation report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical computation and experimental aptitude of the students as applicable. During the dissertation period, every student has to present the progress of their works before the duly constituted committee of Faculty Members of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the dissertation in the form of hard copy must be submitted in the office at least two weeks before the final viva voce is conducted by the External Examiner.