M.Tech Programme

Electrical Engineering- Industrial Instrumentation and Control

Curriculum and Scheme of Examinations

SEMESTER I

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam (hours)	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
EIM 1001	Advanced Engineering Mathematics	3	3	3	40	60	100	Of the 40 marks of internal assessment, 25 marks for tests and 15 marks for assignments. End sem exam is conducted by the University
EIC 1001	Transducers and Measurements	3	3	3	40	60	100	Do
ECC 1003	Dynamics of Linear Systems	3	3	3	40	60	100	Do
EIC 1002	Advanced Signal Processing	3	3	3	40	60	100	Do
EIC 1003	Process Dynamics and Control	3	3	3	40	60	100	Do
EIC 1004	Communication Protocol for Instrumentation	3	3	3	40	60	100	Do
EIC 1101	Instrumentation And Control Lab I	1	2	-	100	-	100	No End Sem Examinations
EIC 1102	Seminar	2	2	-	100	-	100	Do
	TOTAL	21	22		440	360	800	7 Hours of Departmental assistance work

SEMESTER II

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam Hours	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
EIC 2001	Digital Control Theory	3	3	3	40	60	100	Of the 40 marks of internal assessment, 25 marks for tests and 15 marks for assignments. End sem exam is conducted by the University
EIC 2002	Industrial Automation	3	3	3	40	60	100	Do
**	Stream Elective I	3	3	3	40	60	100	Do
**	Stream Elective II	3	3	3	40	60	100	Do
**	Department Elective	3	3	3	40	60	100	Do
ECC 2000	Research Methodology	2	2	3	40	60	100	End Sem Exam is conducted by the Individual Institutions
EIC 2101	Instrumentation And Control Lab II	1	2	-	100		100	No End Sem Examinations
EIC 2102	Seminar	2	2	-	100		100	do
EIC 2103	Thesis – Preliminary – Part I	2	2	-	100		100	do
	TOTAL	22	23	---	540	360	900	6 Hours of Departmental assistance work

STREAM ELECTIVE I

EIE2001	Industrial Management
EIE2002	Process Control System Components
EIE2003	Analog And Digital Instrumentation
EIE2004	Analytical Instrumentation
EIE2005	Adaptive Control Systems

STREAM ELECTIVE II

EIE2006	Fuzzy Logic Neural Network And Control
EIE2007	Artificial Intelligence
EIE2008	Communication Networks
EIE2009	Advanced Micro-controller Applications
ECC2002	Non Linear Control System

List of Department Electives

ECD2001	Industrial Data Networks
ECD2002	Process Control and Industrial Automation
ECD2003	Soft Computing Techniques
ECD2004	Embedded Systems and Real-time Applications
ECD2005	Biomedical Instrumentation
EPD2001	New and Renewable Source of Energy
EPD2002	SCADA System and Application
EMD2001	Electric and Hybrid Vehicles
EDD2001	Power Electronics System Design using ICs
EDD2002	Energy auditing conservation and Management
EDD2003	Advanced Power System Analysis
EDD2004	Industrial Automation Tools
EID2001	Advanced Microprocessors and Microcontrollers
EID2002	Modern Power Converter
EID2003	Power Plant Instrumentation
EID2004	Advanced Control System Design
EID2005	Multivariable Control Theory

SEMESTER III

Code No.	Name of Subject	Credit	Hrs / week	End Sem Exam (hours)	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
**	Stream Elective III	3	3	3	40	60	100	End Sem Exam is conducted by the Individual Institutions
**	Stream Elective IV	3	3	3	40	60	100	Do
**	Non- Dept. (Interdisciplinary) Elective	3	3	3	40	60	100	Do
EIC 3101	Thesis – Preliminary – Part II	5	14	-	200		200	No End Sem Examinations
	TOTAL	14	23		320	180	500	6 Hours of Departmental assistance work

STREAM ELECTIVE III

ECE3001	Robust Control
EIE3002	Advanced Digital System Design
EIE3003	CAD For Digital Control
EIE3004	Optimal Control Systems
EIE3005	Instrumentation in Petrochemical Industries

STREAM ELECTIVE IV

EIE3006	Intelligent Instrumentation
EIE3007	Optical Instrumentation
EIE3008	Virtual Instrumentation
EIE3009	Fibre Optics And Laser Instrumentation
EIE3010	AI Application In Optimisation

SEMESTER IV

Code No	Subject Name	Credits	Hrs/ week	Marks				
				Continuous Assessment		University Exam		Total
				Guide	Evaluation Committee	Thesis Evaluation	Viva Voce	
EIC 4101	Thesis	12	21	150	150	200	100	600
	TOTAL	**12**	**21**	**150**	**150**	**200**	**100**	8 Hours of Departmental assistance work

EIM1001 ADVANCED ENGINEERING MATHEMATICS

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To understand about various mathematical techniques, analyze the mathematical model using mathematical analysis, implement a variety of problem-solving and optimisation strategies

Learning Outcomes

Upon successful completion of this course, students will be able to apply various transformation techniques and vector spaces.

Module I

Probability Distribution, Binomial, Poisson and Hyper geometric Distribution, Normal Distributions, Distribution of several random variables, statistical methods, sampling g distributions- normal, student's distribution, chi square distribution, F – distribution, Estimation of Parameters.

Module II

Discrete Fourier Transforms, Fast Fourier transforms, wavelet transforms, Analytical function – Taylor series, Laurent's series and Problems, conformal transformation – Jon Kowski and Schwarz - Christofer transformation, vector space, Inner Product spaces, Linear transformation

Module III

Optimization methods – local and global minima, line search methods – steepest descent – conjugate gradient method, Solution of Linear algebraic equations – gauss elimination method, Lu decomposition method, Jacobi's and Gauss Seidel iterative methods.

References

1. Erwing Kreyszig, *Advanced Engineering Mathematics*, Wiley Publications, 2007.
2. S. S. Rao, *Optimization Methods*, Prentice Hall India, 1994.
3. Gupta S. C., V.K. Kapoor, *Fundamentals of Statistics*, New Age International, Third Edition, 1996
4. G. Shanker Rao, *Linear Algebra*, I. K. International Publishing House Pvt. Ltd., 2011
5. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, New Delhi, 1998.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIC1001 TRANSDUCERS & MEASUREMENTS

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To understand about various transducers and sensors used in Industry. Analyze various types of transducers and their principle of operation. Understand about signal conditioning techniques.

Learning Outcomes

Upon successful completion of this course, students will be able to choose transducers and sensors and their types, usage and operation and different characteristics of transducers.

Module I

General concepts and terminology of measurement systems- Functional Elements of a measurement system, Methods of measurement. Generalised mathematical model of measurement system. Transducers-definition, classification-analog and digital transducer-primary and secondary transducer-active and passive transducer, Resistive, Inductive, Capacitive transducers, factors influencing choice of transducers. Static and Dynamic characteristics of transducers.

Module II

Temperature (design aspects), Pressure, Flow, Level measurement techniques, pH and conductivity sensors, Piezoelectric, Ultrasonic, Hall effect transducers, Magnetostrictive, Electromagnetic transducers. Concepts of smart/Intelligent transducers.

Module III

Signal Conditioning Techniques, Data acquisition systems block diagram, data transmission, methods of data transmission, Telemetry Systems. Error Analysis: Errors, types of errors, error analysis, methods, statistical analysis of measurement data. Probability of errors. Signal Display/Recording systems, Graphic display systems. Cathode ray oscilloscope and its applications.

References

1. Doeblin E. O., *Measurement Systems*, McGraw-Hill, 1990
2. Patranabis D., *Sensors and Transducers*, Wheeler Publishing Company, New Delhi, 2002.
3. Moorthy D. V. S., *Transducers and Instrumentation*, PHI, New Delhi, 2004
4. Renganathan S., *Transducers Engineering*, Allied Publishers, Chennai, 2003
5. Alan S. Morris, *Principles of Measurement and Instrumentation*, PHI, 2011
6. B.G, Liptak, *Handbook of Process Control & Instrumentation*, CRC Press, 2010
7. Considiine, *Handbook of Process Control & Instrumentation*, 1999

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

ECC1003 DYNAMICS OF LINEAR SYSTEMS 3-0-0-3

Structure of the course

Credits: 3

Lecture : 3 hrs/week
Internal Assessment : 40 Marks
End semester Examination : 60 Marks

Course Objectives

1. To provide a strong foundation on classical and modern control theory.
2. To provide an insight into the role of controllers in a system.
3. To design compensators using classical methods.
4. To design controllers in the state space domain.
5. To impart an in depth knowledge in observer design.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Analyse a given system and assess its performance.
2. Design a suitable compensator to meet the required specifications.
3. Design and tune PID controllers for a given system.
4. Realise a linear system in state space domain and to evaluate controllability and observability.
5. Design a controller and observer for a given system and evaluate its performance.

Module I

Design of feedback control systems- Approaches to system design-compensators-performance measures - cascade compensation networks-phase lead and lag compensator design using both Root locus and Bode plots-systems using integration networks, systems with pre-filter, PID controllers-effect of proportional, integral and derivative gains on system performance, PID tuning , integral windup and solutions.

Module II

State Space Analysis and Design- Analysis of stabilization by pole cancellation - Canonical realizations - Parallel and cascade realizations - reachability and constructability - stabilizability - controllability - observability -grammians. Linear state variable feedback for SISO systems, Analysis of stabilization by output feedback-modal controllability-formulae for feedback gain -significance of controllable Canonic form-Ackermann's formula- feedback gains in terms of Eigen values - Mayne-Murdoch formula - Transfer function approach - state feedback and zeros of the transfer function - non controllable realizations and stabilizability - controllable and uncontrollable modes - regulator problems - non zero set points - constant input disturbances and integral feedback.

Module III

Observers: Asymptotic observers for state measurement-open loop observer-closed loop observer-formulae for observer gain - implementation of the observer - full order and reduced order observers - separation principle - combined observer -controller – optimality criterion for choosing observer poles - direct transfer function design procedures - Design using polynomial equations - Direct analysis of the Diophantine equation.
MIMO systems: Introduction, controllability, observability, different companion forms.

References

1. Thomas Kailath, *Linear System*, Prentice Hall Inc., Eaglewood Cliffs, NJ, 1998
2. Benjamin C. Kuo, *Control Systems*, Tata McGraw-Hill, 2002
3. M. Gopal, *Control Systems-Principles and Design*, Tata McGraw-Hill
4. Richard C. Dorf & Robert H. Bishop, *Modern Control Systems*, Addison Wesley, 8th Edition, 1998
5. Gene K. Franklin & J. David Powell, *Feedback Control of Dynamic Systems*, Addison - Wesley, 3rd Edition
6. Friedland B., *Control System Design: An Introduction to State Space Methods*, McGraw-Hill, NY 1986
7. M. R. Chidambaram and S. Ganapathy, *An Introduction to the Control of Dynamic Systems*, Sehgal Educational Publishers, 1979
8. C.T. Chen, *Linear System Theory and Design*, Oxford University Press, New York, 1999

Structure of the question paper

For the end semester examination, the question paper consists of at least 60% design problems and derivations. The question paper contains three questions from each module out of which two questions are to be answered by the student.

EIC1002 ADVANCED SIGNAL PROCESSING

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To learn about DSP techniques.

Learning Outcomes

Upon successful completion of this course, students will be able to apply signal processing strategies.

Module I

Review of DTS-Discrete time Signals-Sequences –Stability and Causality –Frequency domain Representation of Discrete time Systems and Signals –Two-dimensional Sequences and Systems –Z-Transform –Z- Transform Theorems and Properties –Two-dimensional Z-Transform. Structures for discrete time system– Direct, cascade and parallel forms –Lattice structure. Representation of Periodic Sequences-the Discrete Fourier Series –Properties of the discrete Fourier series –Sampling, Z-transform –discrete Fourier transform –properties of discrete Fourier Transform –Linear Convolution –Decimation –in- Time and Decimation in- Frequency –FFT Algorithms.

Module II

Digital Filter Design Techniques-Introduction – Design of IIR Digital Filters from Analog Filters – Analog –Digital Transformation –Properties of FIR Digital Filters –Design of FIR Filters Using Windows –A Comparison of IIR and FIR Digital Filters. Finite Register Length Effects-Introduction - Effects of coefficient on Quantization –Quantization in Sampling -Analog Signals - Finite Register Length effects in realizations of Digital Filters – discrete Fourier Transform Computations

Module III

Time frequency analysis, the need for time frequency analysis, Time frequency distribution, Short time Fourier Transform, Wigner distribution. Multirate digital signal processing: Basic multirate operation (up sampling, down sampling), Efficient structures for decimation and interpolation, Decimation and interpolation with polyphase filters, Noninteger sampling rate conversion , Efficient multirate filtering Applications, Oversampled A/D and D/A converter. Introduction to Digital Signal Processors-Commercial DSP devices – TMS C240 processor and ADSP 2181 processor –Architecture – Addressing modes – Program control – Instruction and programming –Simple programs.

References

1. Emmanuel C. Ifeachor, Barrie W. Jervis, *Digital Signal Processing: A Practical Approach*, Pearson Education India Series, New Delhi, 2nd Edition, 2004
2. Sanjit K. Mitra, *Digital Signals Processing: A Computer Based Approach*, Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2004.
3. Alan Oppenheim V., Ronald W. Schafer, '*Digital Signal Processing'*, Prentice Hall of India Private. Limited. New Delhi, 1989.
4. John G. Proakis and Manolakis. D.G, '*Digital Signal Processing: Principles Algorithms and Applications'*, Prentice Hall of India, New Delhi, 2004.
5. Oppenheim V. and Ronald W. Schafer, '*Discrete Time Signal Processing'*, Prentice Hall of India Private Limited., New Delhi, 2001.
6. Leon Cohen, '*Time Frequency Analysis'*, Prentice Hall, 1995.
7. P. P. Vaidyanathan, '*Multirate systems and Filter Banks'*, Prentice Hall, 1993
8. Avatar Singh and Srinivasan S., '*Digital Signal Processing: Implementation using DSP Microprocessors with Examples from TMS 320C54XX*', Thompson Brooks/Cole, 2004.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIC1003 **PROCESS DYNAMICS AND CONTROL**

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To acquaint students with skills in modelling of the dynamics of physical/chemical process systems, educate students with various advanced concepts in process Control**.**

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. The students will be fully equipped with a thorough understanding of different physical/chemical processes.
2. Build dynamic models of any given physical /chemical process system
3. Advanced process control strategies including computer control so that the employability skills (for a process industry) will be enhanced

Module I

Introduction to physical/chemical process systems - Concept of a process, Continuous and batch processes. A brief outline of material processing technologies, fluid flow, heat transfer and mass transfer systems, Absorbers, distillation columns, heat exchangers, reaction systems, blending systems. Need for modeling of dynamic systems. General principles of modeling of dynamic systems. Degrees of freedom. .First order, second order and higher order models. Transfer function models. Models of liquid level systems, mixing systems, reactors and liquid heating systems.

Module II

Control loops for simple systems: block diagrams. Dynamics and stability. Tuning of controllers, Zeigler Nichols, Cohen & Coon techniques. Auto Tuning. . Different control techniques and interaction of process parameters - Feed forward, cascade, ratio, override control. Multi variable control. Feed forward control schemes. Characteristics of ON-OFF, P, PI, PD and PID control schemes. Electronic PID controller, Digital PID algorithms. Practical forms of PID controller. Generation of control actions in electronic and pneumatic controllers. Pneumatic and electric actuators. Control valves, valve-positioners, Relief and safety valves, Relays, Volume boosters, solenoid and stepper motors. Pneumatic transmitters for process variables.

Module III

Data Acquisition System-data Logger. Control schemes for distillation columns, absorbers, heat exchangers, furnaces, reactors, pH and blending processes. Computer control of processes: direct Digital control (DDC), Supervisory control and advanced control strategies. Control loop characteristics-control system configuration -control objectives- Internal Model Controller-P&ID diagram. Measurement, control and transmission of signals of process parameters like flow, pressure, level and temperature.

References

1. Stephananopoulos G., *Chemical Process Control - An Introduction Theory and Practice*, PHI, 1990.
2. S. K Singh, *Process Control Concept, Dynamics and Application*, PHI, New Delhi, 2009
3. Harriot, *Process Control*, TMH, New Delhi, 2008.
4. Thomas E. Marlin, '*Process Control Designing Process And Control System For Dynamic Perfomance*', Tata McGraw-Hill, 2000.
5. Johnson, C., *Process Control Instrumentation Technology*, PHI New Delhi, 2005.
6. Bequette B.W., *Process Control Modelling, Design and Simulations,* Prentice Hall of India, 2004
7. Coughanower and Koppel, *Process System Analysis and Control*, McGraw-Hill, 1991.
8. Luyben W. L., *Simulation and Control for Chemical Engineers*, 1989, 2nd Edition, McGraw-Hill.
9. McCabe & Smith, *Unit Operations of Chemical Engineering*, Tata McGraw-Hill, New Delhi, 1997

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIC1004 COMMUNICATION PROTOCOL FOR INSTRUMENTATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To give exposure to Hierarchical Structure of networks used in Automation and Control Systems. To Understand ISO OSI Seven Layer Communication Structure. To Learn communication interfaces viz. RS 232, RS485, Ethernet. To Learn communication protocols viz. MODBUS

Learning Outcomes

Upon successful completion of this course, students will be able to apply the understanding of different Industrial communication standard. They will be familiar with different Protocols including wireless standards so that the employability skills will be enhanced.

Module I

Introduction -An Introduction to Networks in process automation: Information flow requirements - Hierarchical Communication model - Data Communication basics - OSI reference model - Industry Network - Recent networks Communication protocols - Introduction to Communication Protocols: Communication basics – Network Classification - Device Networks - Control Networks - Enterprise Networking - Network selection.

Module II

Network architectures-Proprietary and open networks: Network Architectures - Building blocks – Industry open protocols (RS-232C, RS- 422, and RS-485) - Ethernet – Mod bus – Mod bus Plus - Data Highway Plus - Advantages and Limitations of Open networks - IEEE 1-394. Field bus: Field bus Trends - Hardware selection - Field bus design - Installation - Documentation, Field bus advantages and limitations.USB.

Module III

HART: Introduction - Design - Installation - calibration, Commissioning - Application in Hazardous and Non-Hazardous area. Planning and commissioning -Foundation Field bus & Profibus: Introduction - Design -Commissioning - Application in Hazardous and Non-Hazardous area - Introduction to wireless Protocols: WPAN - Wi-Fi - Bluetooth - ZigBee - Z-wave.

References

1. B.G. Liptak, *Process Software and Digital Networks*, CRC Press ISA, 2002.
2. Romilly Bowden, *HART Communications Protocol*, Fisher-Rosemount, 2003..
3. User Manuals of Foundation Field bus, Profibus, Modbus, Ethernet, Device net, Control net.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIC1101 INSTRUMENTATION AND CONTROL LAB - I

Structure of the Course

Practical	: 2 hrs/week	Credits : 1
Internal Continuous Assessment	: 100 Marks	

Course Objective

Familiarizing the students about transducers used in a process, acquiring the data processing and controlling the process.

Learning Outcomes

Upon successful completion of this course, students will be able to implement process techniques, instrumental setups as well as controlling and monitoring of various process stations.

Experiments

- Study and use of Transducers.
    1. Strain Gauge.
    2. L.V.D.T
    3. Thermocouple.
    4. Dead Weight.
    5. Load Cell.
- Experiments on Process Simulator
    1. First Order Systems.
    2. Second Order Systems.
- Experiments on Process Control Stations
    9. Temperature Control Plant.
    10. Pressure Control Plant.
    11. Flow Control Plant.
    12. Level Control Plant.
- Use of Essential Software tools for Control and Instrumentation system Design (MATLAB/SIMULINK)

EIC1102 SEMINAR

Structure of the Course

Seminar	: 2 hrs/week	Credits : 2
Internal Continuous Assessment	: 100 Marks	

The student is expected to present a seminar in one of the current topics in Industrial Instrumentation and Control and related areas. The student will undertake a detailed study based on current journals, published papers, books, on the chosen subject and submit seminar report at the end of the semester.

Marks:	Seminar Report Evaluation	: 50
	Seminar Presentation	: 50

EIC2001 DIGITAL CONTROL THEORY

Structure of the course

Lecture	: 3 hrs/week
Internal Assessment	: 40 Marks
End semester Examination	: 60 Marks

Course Objectives

1. To introduce the concepts of digital control.
2. To analyse the stability using different methods.
3. To design compensators using classical methods.
4. To impart in-depth knowledge in state space design of digital controllers and observers.
5. To analyse the system performance with controller and estimator in closed loop.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Analyse a given discrete-time system and assess its performance.
2. Design a suitable digital controller for a given system to meet the specifications.
3. Design a digital controller and observer for a given system and evaluate its performance.

Module I

Analysis in Z-domain: Review of Z Transforms, Pulse Transfer Function and sample and hold, effect of damping, mapping between the s plane and the z plane, stability analysis of closed loop systems in the z-plane, Jury's test, Schur Cohn test, Bilinear Transformation, Routh-Hurwitz method in w-plane. Discrete equivalents: Discrete equivalents via numerical integration-pole-zero matching-hold equivalents.

Module II

Digital Controller Design for SISO systems: Design based on root locus method in the z-plane, design based on frequency response method design of lag compensator, lead compensator , lag lead compensator, design of PID Controller based on frequency response method- Direct Design-method of Ragazzini. Design using State Space approach, pulse transfer function matrix, discretization of continuous time state space equations, Controllability, Observability, Control Law Design, decoupling by state variable feedback, effect of sampling period.

Module III

Estimator/Observer Design: Full order observers - reduced order observers, Regulator Design, Separation Principle -case with reference input. MIMO systems: Introduction to MIMO systems, Design Concept - Case Studies.

References

1. Gene F. Franklin, J. David Powell, Michael Workman, *Digital Control of Dynamic Systems*, Pearson, Asia, 2000.
2. J. R. Liegh, *Applied Digital Control*, Rinchart & Winston Inc., New Delhi, 2010.
3. Frank L. Lewis, *Applied Optimal Control & Estimation*, Prentice-Hall, Englewood Cliffs NJ, 1992.
4. Benjamin C. Kuo, *Digital Control Systems*, 2nd Edition, Saunders College publishing, Philadelphia, 1992.
5. K. Ogata, 'Discrete-Time Control Systems', Pearson Education, Asia, 2013.
6. C. L. Philips, H. T. Nagle, *Digital Control Systems*, Prentice-Hall, Englewood Cliffs, New Jersey, 1995.
7. R. G. Jacquot, *Modern Digital Control Systems*, Marcel Decker, New York, 1995.
8. M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw-Hill, 1997.

Structure of the question paper

For the end semester examination, the question paper contains three questions from each module (excluding the review part) out of which two questions are to be answered by the student.

EIC2002 **INDUSTRIAL AUTOMATION**

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide knowledge in various Automation methodologies used in process industries

Learning Outcomes

Upon successful completion of this course, students will be able to

1. Comprehend different Automation process.
2. Implementation of automation using automation tools (PLC, SCADA, DCS).
3. Reckon with advanced process control strategies including computer control so that the employability skills (for a process industry) will be enhanced.

Module I

Introduction to automation tools PLC, DCS, and SCADA. Programmable logic controllers (PLC): hardware and software aspects, architecture PLC vs. PC, ladder diagram, ladder diagram examples, timers/counters, shift register, PLC Communication and networking-selection and installation of PLC- Safety Instrumented Systems (SIS), Safety Integrity Level (SI L), Triple Modular redundancy (TMR), Safety PLC. Input/output modules, study of SCADA software, Interfacing of PLC with SCADA software.

Module II

Distributed Control Systems: DCS introduction, functions, advantages and limitations, DCS as an automation tool to support Enterprise Resources Planning, DCS Architecture of different makes, specifications, configuration, functions including database management, reporting, alarm management, communication, third party interface display etc. DCS supervisory computer task, DCS integration with PLC and computer Communication protocols employed in DCS- FDDI, Ethernet-TCP/IP

Module III

Case study: Automation of Hot strip mill in integrated steel plant. Computer aided control of electric power generation plant. Study of Advance Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, neural network control (Basics Only) Control & Instrumentation for process optimization Applications of the above techniques to the some standard units/processes

References

1. Gary Dunning, '*Introduction to Programmable Logic Controllers*', Delmar Publisher, 2006
2. S. K. Singh, *Process Control*, Prentice Hall India, 2009
3. Jose A. Romagnoli, AhmetPalazoglu, *Introduction to Process Control*, CRC Taylor and Francis Group, 2012
4. *Statistical Process Control*, ISA Handbook, 2010
5. B. G. Liptak, *Handbook of Instrumentation*: *Process Control*, 2010
6. Installation and user manuals of different DCS, PLC Vendors, 2002
7. Parr A., *Programmable Controllers: An Engineers Guide*, Newnes, Butterworth-Heinneman Ltd., 1993.
8. Poppovik Bhatkar, *Distributed Computer Control for Industrial Automation*, PHI, 1987
9. Webb & Reis, *Programmable logic Controllers,* Prentice Hall of India,5th Edition, 2003
10. N. E. Battikha, *The Management of Control System: Justification and Technical Auditing*, ISA, 1992
11. IEC61508 , IEC61511-2011

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2001 INDUSTRIAL MANAGEMENT

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide an insight theory on Industrial Managing Systems

Learning Outcomes

Upon successful completion of this course, students will be able to implement basic management strategies as well as various business policies.

Module I

Strategic Industrial Management -Introduction to Management, definition, functions, and principles. Strategic planning, types of business strategy, Business environment, SWOT analysis, Developing competitive advantage profile and Environmental, Threat and opportunity Profile. BCG Matrix porter's 5 forces of competition Management techniques for developing strategy Viz., Balanced score card, opportunity Identification, Area Vs product Matrix, Mind Mapping etc, performance Management and analysis techniques viz, Ishikawa/Reverse Ishikawa diagrams, Business process Re-engineering.

Module II

Quality, Health and Environment Management and Enterprise Excellence Quality Circles/Forums, Quality Objectives, use of Statistical Process control, Introduction to ISO 9000 and Role of R & D, Innovation, Industry Institute Interaction, Long Term Economic Stability Business expansion, diversion, Mergers and Takeovers, Global Market, Exports orientation, Effect of GAT/WTO agreement, Introduction to Intellectual property Right, patent and copy right. Production Planning, Inventory Control and Supply Chain Management Manufacturing Excellence, Outsourcing, Production planning techniques, handling and storage, Value Addition, Supply Chain concepts and management for leveraging profit. Human Resources Management Manpower planning, Human Resources: exploiting true potential, Staff training and development, Motivation, Selection and training of manpower, Appraisal and increments management, Leadership skills, Delegation and development for growth, objectives and job Description/Role summary.

Module III

Financial & Project Management Capital Structure, Fixed & working capital, sources of finance. Introduction to capital budgeting, Methods of capital budgeting. Break even analysis, assumptions, importance, CVP graph, Role of Securities and Exchange Board of India (SEBI) , function of money market and capital Market, Project Management, Project network analysis, CPM, PERT and Project crashing and resource Leveling. Purchase and Inventory Management, Inventory control using Economic Order Quantity, Minimum Order Quality, Ordering Level, store keeping, Finished goods, semi finished goods, raw material

References

1. Bell and James Balkwill, '*Management in Engineering Gail Freeman*', (PHI), 1996
2. T. R. Bange and S. C. Sharma, '*Industrial Organization And Engineering Economic*', 1996
3. C. D. Stevens, '*Engineering Economics*', 2000
4. Azar Kazmi, '*Strategic Management and Business Policy*', 3rd Edition, Tata McGraw-Hill, 2008
5. Halbert, Taylor & Francis, '*Resisting Intellectual Property*', 2007, EIE

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2002 PROCESS CONTROL SYSTEM COMPONENTS

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To design sensors for various industrial parameters to study computer based controllers

Learning Outcomes

Upon successful completion of this course, students will be able to choose various components for controlling a process industry, their design ideas, specification requirements and incorporation of computer to enhance process quality and outcome.

Module I

Design of flow and temperature sensors-Orifice meter – Design of Orifice for given flow conditions – Design of Rotameter – Design of RTD measuring circuit – Design of cold junction compensation circuit for thermocouple using RTD –Transmitters – Zero and span adjustment in D/P transmitters and temperature transmitters. Design of pressure sensors-Bourdon gauges – factors affecting sensitivity -design of Bourdon tube -Design of air purge system for level measurement. Design of Electrical methods in pressure measuring - strain gauges.

Module II

Pumps-Type of pumps – Pump performance – pipe work calculation –characteristics of different pumps-pump operation, maintenance instruments used in pumping practice – pump noise and vibration– selection of pumps. Microprocessor based controllers -Design of microprocessor based system for data acquisition – Design of microprocessor based PID controller

Module III

Computer based controllers -Design of computer controlled system – Software design, Single program approach, Multi –Testing Approach, Structured development for real time systems, computerized distributed control system; Merits and demerits, requirements and topologies of distributed control system. microprocessor based system D.C motor speed control – Temperature control.

References

1. N. A. Anderson, ‘*Instrumentation for Process Measurement and Control’*, CRC Press, 1997.
2. D. M. Considine, ‘*Process Instruments and Controls Handbook*’, Tata McGraw-Hill Book, 1993.
3. R. H. Warring, ‘*Pumping Manual’*, Gulg Publishing Co., 1984.
4. J. P. Bentley, ‘*Principles of Measurement Systems’*, Pearson Prentice Hall, 2005.
5. C. D. Johnson, ‘*Process Control Instrumentation Technology’* Prentice Hall Inc., 2007.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2003 ANALOG AND DIGITAL INSTRUMENTATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To study about various Data Acquisition and Transmission System and to study about various PC based Control and Instrumentation

Learning Outcomes

Upon successful completion of this course, students will be able to understand about various analog and digital instruments, their processing and communications.

Module I

Basic blocks- Overview of A/D converter, types and characteristics-Understanding Data acquisition, A/D and S/H terms-passive support and Active support components-Single and Multi-slope, Low cost A/D conversion techniques, types-Electromechanical A/D converter. Data acquisition systems Objective - Building blocks of Automation systems – Multi, Single channel Data Acquisition systems, PC based DAS, Data loggers- Sensors based computer data systems.

Module II

Interfacing and data transmission Data transmission systems- 8086 Microprocessor based system design - Peripheral Interfaces – Time Division Multiplexing (TDM) – Digital Modulation – Pulse Modulation – Pulse Code Format – Interface systems and standards – Communications. PC based instrumentation Introduction - Evolution of signal Standard - HART Communication protocol - Communication modes - HART networks - control system interface - HART commands -HART field controller implementation - HART and the OSI model.

Module III

Field bus –Introduction - General field bus architecture - Basic requirements of field bus standard -field bus topology - Interoperability – interchangeability - Instrumentation buses-Mod bus - GPIB - Network buses – Ethernet - TCP/IP protocols Case studies PC based industrial process measurements like flow, temperature, pressure and level – PC based Instruments development system.

Reference

1. Kevin M. Daugherty, *Analog - Digital conversion: A Practical Approach*, Tata McGraw-Hill International Editions, 1995
2. N. Mathivanan, *Microprocessors, PC Hardware and Interfacing*, Prentice Hall India, 2003.
3. Krishna Kant, *Computer- based Industrial Control*, Prentice Hall India Pvt. Ltd., 2004.
4. H. S. Khalsi, *Electronic Instrumentation*, Technical Education Series Tata McGraw-Hill, 2004.
5. Buchanan, *Computer busses*, Arnold, London, 2000.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2004 ANALYTICAL INSTRUMENTATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide an insight on instrumental methods.

Learning Outcomes

Upon successful completion of this course, students will be able to choose analytical instruments according to the application.

Module I

Introduction- Difference between analytical and other instruments. Online instrumentation and laboratory, Classical and Instrumental methods, Classification of Instrumental techniques, important considerations in evaluating an instrumental method, Absorption methods- Spectrometric UV and VIS methods- Laws of photometry, IR spectrometry: correlation of IR spectra with molecular structure.

Module II

Atomic absorption spectrometry: Principle, Instrumentation Emission methods: Flame, AC/DC arc, spark, plasma excitation sources, instrumentation in Spectrofluroscence and phosphorescence spectrometer: Instrumentation, Raman spectrometer. Mass spectrometer: Ionisation methods, mass analysers, mass detectors, FTMS. Chromatography: Classification, Gas chromatography, Liquid chromatography.

Module III

X-ray and Nuclear methods: X-ray absorption, fluorescence and diffractometric techniques, electron microscope and microprobe, ESCA and Auger techniques, nuclear radiation detectors. NMR spectroscopy: Principle, chemical shift, spin-spin coupling, instrumentation, types of NMR. Electroanalytical methods: potentiometry, voltammetry, coulometry techniques

References

1. Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th edition, CBS Publishers, New Delhi, 1974
2. Galen W. Ewing, *Instrumental Methods of Chemical Analysis*, 5th edition, McGraw-Hill Book, 1985
3. Patranabis D., *Principles of Industrial Instrumentation*, TMH publication, New Delhi, 1976.
4. Liptak B. G., *Instrument Engineers Handbook, Volume I and II and supplement I and II, Chilton book Co*., Philadelphia, 1972.
5. Jones E. B., '*Instrument Technology, Volume II, Analysis instruments'*, Butterworth Scientific Publication, London, 1953
6. O'Higgins P. J., *Basic Instrumentation in Industrial Measurements*, McGraw-Hill, NY, 1966.
7. Skoog D. A. and West D. M., *Principles of Instrumental Analysis*, 2005

Structure of the Question paper

For the end semester examinations, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2005 **ADAPTIVE CONTROL SYSTEMS**

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide the fundamental concepts of adaptive control theory

Learning Outcomes

Upon successful completion of this course, students will be acquainted with different adaptive control strategies.

Module I

Introduction: Parametric models of dynamical systems, Adaptive control problem. Real time parameter estimation: Least squares and regression models, Estimating parameters in Dynamical Systems, Experimental conditions, Prior information. Deterministic Self tuning regulators (STR): Pole placement design, Indirect self tuning regulators, Continuous time self tuners, Direct self tuning regulators, disturbances with known characteristics.

Module II

Stochastic and Predictive Self tuning regulators: Design of Minimum variance and Moving average controllers, Stochastic self tuning regulators, Unification of direct self tuning regulators. Linear quadratic STR, adaptive predictive control. Model reference adaptive control (MRAS): The MIT Rule, Determination of adaptation gain, Lyapunov theory, Design of MRAS using Lyapunov theory, BIBO stability, Output feedback, Relations between MRAS and STR.

Module III

Properties of Adaptive systems: Nonlinear dynamics, Analysis of Indirect discrete time self tuners, Stabilty of direct discrete time algorithms, Averaging, Application of averaging techniques, Averaging in stochastic systems, Robust adaptive controllers

References

1. Petros Ioannou, Baris Fidan, *Adaptive Control Tutorial*, SIAM, 2006
2. P. A. Ioannou and J. Sun, *Robust Adaptive Control*, Prentice Hall, 1995
3. Sankar Sastry and Marc Bodson, *Adaptive Control- Stability, Convergence and Robustness*, Springer, 2011
4. M. Krstic, I. Kanellakopoulos, P. Kokotovic, *Nonlinear and Adaptive Control Design*, Wiley- Interscience, 1995
5. H. K. Khalil, *Nonlinear Systems*, Prentice Hall, 3rd ed., 2002
6. K. J. Astrom and B. Wittenmark, *Adaptive Control*, 2nd Edition, Pearson Education, 1995
7. Jean-Jacques Slotine, Weiping Li, *Applied Nonlinear Control*, Prentice Hall, 1991, ISBN: 0-13-040890.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2006 FUZZY LOGIC NEURAL NETWORK AND CONTROL

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To acquaint the students in Artificial Networks and Fuzzy systems

Learning Outcomes

Upon successful completion of this course, students will be able to create fuzzy systems and neural networks for the application in control systems.

Module I

Introduction to Neural Networks, Biological concept, Basic properties of neurons, Artificial Neurons, Activation Functions, Single layer and multilayer networks, Supervised and Unsupervised Learning, Back Propagation Algorithm, ANN Based Control, Control Structures-model reference control, internal reference control, predictive control.

Module II

Introduction to Fuzzy Logic: Basics of fuzzy sets, members, properties and systems, membership functions. Fuzzy Logic based control: Fuzzy controllers, Basic construction of fuzzy controllers. Case studies- Fuzzy control for smart cars, Fuzzy control for Washing Machines.

Module III

Neuro-Fuzzy and Fuzzy-Neural Controllers, Neuro-Fuzzy systems, Construction of rule basis by self learning, A hybrid neural network based fuzzy controller with self learning teacher. Artificial Intelligent Systems and its applications

References

1. Simon Haykin, *Neural Networks*, 1999
2. Robert J. Schalkoff, *Artificial Neural Networks,* McGraw-Hill, 1997.
3. Kosco B., N*eural Networks and Fuzzy Systems - A Dynamic Approach to Machine Intelligence,* PHI, New Delhi, 1994.
4. Klir G. J. and Folger T. A., *Fuzzy Sets: Uncertainity and Information*, Prentice Hall of India, 1998
5. Bose and Liang, '*Artificial Neural Networks'*, Tata McGraw-Hill, 2002.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2007 **ARTIFICIAL INTELLIGENCE**

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To introduce advanced theory and practical techniques in Artificial Intelligence. To introduce Expert systems.

Learning Outcomes

Upon successful completion of this course, students will be able to understand intelligent and expert systems.

Module I

Basic problem solving methods : Production systems – State space search – Control strategies – Heuristic search – Forward and backward reasoning – Hill Climbing techniques – Breadth first search – Depth first search – Best search – Staged search.

Module II

Knowledge representation : Predicate logic – Resolution Question answering – Nonmonotic reasoning – Statistical and probabilistic reasoning – Semantic Nets – Cenceptual dependency – Frames – Scripts. AI Languages : Important characteristics of AI languages – PROLOG.

Module III

Introduction to expert system – interaction with an expert. Design of an expert system. Neural Networks : Basic structure of a neuron, Supervised & un supervised, Single layer and multi layer, Feed forward, Back propagation.

References

1. Rich E. and Knight K., *Artificial Intelligence*, Tata McGraw-Hill, New Delhi, 1991.
2. Nilsson N. J., *Principles of Artificial Intelligence*, Springer Verlag, Berlin, 1980.
3. Barr A., Fergenbaum E. A. and Cohen P. R., *Artificial Intelligences*, Addison Wesley, Reading (Mass), 1989.
4. Waterman D. A., *A Guide to Expert System*, Addison-Wesley, Reading (Mass), 1986.
5. *Artificial Intelligence Handbook*, Vol. 1-2, ISA, Research Triangle Park, 1989.
6. Kos Ko B., *Neural Networks and Fuzzy System*, PHI, 1992.
7. Russel, *Artificial Intelligence*, Pearson, 2010.
8. Luger, *Artificial Intelligence*, 4/e Pearson, 2009.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2008 COMMUNICATION NETWORKS

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide an insight to theory of communication network protocol

Learning Outcomes

Upon successful completion of this course, students will have an idea about various network and strategies for communication.

Module I

General issues in the transport of data – traffic over networks of digital transmission media. Architectural concepts in ISO's. OSI layered model for communication. Physical layer standards.

Module II

Data link layer; ARO schemes and their analysis, delay models based on queing theory, network layer: Topology routing, flow control, congestion control, internetworking.

Module III

Multiple access, local area networks, IEEE standard for LAN's, transport layer; issues and standards, integrated services networks: ISDN, B-ISDN, ATM.

References

1. Bertsekos. D, Gallajer. R. , *Data Networks,* Prentice Hall India, 1989
2. Tanenbaum A.S, *Computer Networks,* 2nd edition, Prentice Hall India, 1980
3. Mischar Schwartz, *Telecommunication Networks Protocols - Modeling and Analysis* Addison Wesley, 1987.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE2009 ADVANCED MICRO-CONTROLLER APPLICATIONS

Structure of the course

Lecture	: 3hrs/Week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide experience to design digital and analog hardware interface for microcontroller based systems. To provide experience to integrate hardware and software for microcontroller applications. To provide experience to debug a microcontroller-based system and to analyse its performance using advanced debug tools and electronic test instrumentation

Learning Outcomes

Upon successful completion of this course, students will be able to implement microcontrollers for various applications.

Module I

History of microcomputers. Over view of 8051, 8096, 6811, 6812 and 8051 architecture. Hardware system, Mode of operation, Hardware pin assignments, Programming model.

Module II

Assembly language, instruction, execution cycle, Instruction set. Addressing modes, Advancedassembly programming. Interrupts, General interrupts, concepts of ISR. 8051 Timer Module, Components of the timer module. Timer /counter programming of 8051.

Module III

Serial I/O ports of 8051. Interrupts in 8051. Interfacing keyboard, temperature sensor and stepper motor to 8051. Interfacing ADC and DAC to 8051. Real Time Clock- DC Motor Speed Control-Generation of Gating Signals for Converters And Inverters- Frequency Measurement – Temperature Control.

References

1. Kenneth J. Ayala, *The 8051 Micro-controller*, West Publishing, 2004
2. Jonathan W. Valvano, *Introduction to Embedded Microcomputer System'*, 2011.
3. John B. Peatman, *Design with microcontrollers*, McGraw-Hill International Ltd., Singapore, 1989.
4. Santa Clara, Intel Manual on 16 Bit Embedded Controllers, 2nd Edition, 1991
5. Myko Predko, '*Programming and Customizing the 8051 Microcontroller'*, Tata McGraw-Hill, 1999.
6. Muhammad Ali Mazidi, Janice Gillispie Mazidi, '*The 8051 Microcontroller and Embedded Systems'*, Pearson Education, 2004.
7. Michael Slater, *Microprocessor based design - A Comprehensive Guide To Effective Hardware Design*, Prentice Hall, New Jersey, 1989

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

ECC2002 NONLINEAR CONTROL SYSTEMS

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

1. To study the essentials of Non-linear control.
2. To extend the analysis techniques for classical control theory to nonlinear system.
3. To analyse the physical system with inherent non-linearity for stability and performance.
4. To provide the necessary methods for designing controllers for Non-linear systems.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Gain insight into the complexity of nonlinear systems.
2. Apply methods of characterizing and understanding the behaviour of systems that can be described by nonlinear ordinary differential equations.
3. Use tools including graphical and analytical for analysis of nonlinear control systems.
4. Use a complete treatment of design concepts for linearization via feedback.
5. Demonstrate an ability to interact and communicate effectively with peers.

Module I

Describing function analysis: Fundamentals-Describing Function of saturation, dead-zone, on-off non-linearity, backlash, Hysteresis-Describing Function Analysis of Non-linear Systems, Dual Input Describing Function (DIDF)-Existence of Limit Cycles.
Phase plane analysis: Concept of Phase Portraits-Singular Points Characterization – Analysis of Non-linear Systems Using Phase Plane Technique – Classification of Equilibrium Points-Stable & Unstable – Limit Cycle Analysis- Existence – Stability.

Module II

Concept of stability: Definition of Stability - Stability in the Sense of Lyapunov, Analysis of Instability, Absolute Stability, Zero- Input and BIBO Stability, Second method of Lyapunov- Stability theory for Continuous and Discrete Time Systems - Aizermanns and Kalman's conjecture - Construction of Lyapunov function for non linear systems - Methods of Aizerman- Zubov - Variable Gradient Method.

Absolute Stability:- Lure’s Problem - Kalman- Yakubovich-Popov Lemma - Circle Criterion Popov's stability Criterion - Popov's Hyper Stability Theorem.

Module III

Non-linear control system design: Design via Linearization – Stabilization – Regulation via Integral Control – Gain Scheduling Feedback Linearization – Stabilization – tracking – Regulation via Integral Control - Cascade Designs-Back Stepping Design.

References

1. Hassan K Khalil, *Nonlinear Systems*, Mcmillan Publishing Company, NJ, 2004.
2. John E Gibson, *Nonlinear Automatic Control*, McGraw-Hill, NewYork, 1963.
3. Jean-Jacques E. Slotine, Weiping Li, *Applied Nonlinear Control*, Prentice-Hall, NJ, 1991.
4. M. Vidyasagar, Nonlinear *Systems Analysis*, Prentice-Hall, India, 1991,
5. Shankar Sastry, Nonlinear *System Analysis - Stability and Control*, Springer, 1999.
6. Alberto Isidori, *Nonlinear Control Systems: An Introduction*, Springer-Verlag, 1985.

Structure of the question paper

For the end semester examination, the question paper consists of at least 60% design problems and derivations. The question paper contains three questions from each module out of which two questions are to be answered by the student.

EID2001 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide experience to design digital and analog hardware interface for microcontroller based systems. To provide in depth knowledge of higher bit processors

Learning Outcomes

Upon successful completion of this course, students will be able to use microprocessors and microcontrollers for different applications.

Module I

Internal architecture of 8086 CPU, instruction set and programming, assembly language programming on IBM PC, ROM bios and DOS utilities. 8086 basic system concepts, signals, instruction queue, MIN mode and MAX mode, bus cycle, memory interface, read and write bus cycles, timing parameters.

Module II

Input/output interface of 8086, I/O data transfer, I/O bus cycle. Interrupt interface of 8086, types of interrupts, interrupt processing. DMA transfer, interfacing and refreshing DRAM, 8086 based multiprocessing system, 8087 math coprocessor. Typical 8086 based system configuration, keyboard interface, CRT controller, floppy disk controller

Module III

Introduction to higher bit processors, 80286, 80386, 80486, Pentium. A typical 16 bit Microcontroller with RISC architecture and Integrated A-D converter e.g. PIC 18Cxxx family: Advantages of Harvard Architecture, instruction pipeline, analog input, PWM output, serial I/O, timers, in-circuit and self programmability. Instruction set. Typical application. Development tools.

References

1. Ray A. K., Bhurchandi K. M., *Advanced Microprocessor and Peripherals, Architecture, Programming and Interfacing*, TMH, 2006
2. Hall D.V., *Microprocessor & Interfacing – Programming & Hardware – 8086, 80286, 80386, 80486*', TMH, 1992
3. Rajasree Y., *Advanced Microprocessor*, New Age International Publishers, 2008
4. Brey B. B. '*The Intel Microprocessor 8086/8088*, *Pentium , Pentium Processor,* PHI, 2008
5. Ayala K. J., *The 8086 Microprocessor*, Thomson Delmar Learning, 2004.
6. Cady F. M., *Microcontrollers & Microcomputers Principles of Software &Hardware Engineering*, Oxford University Press, 1997
7. Tabak D., *Advanced Microprocessors*,TMH, 1996
8. Deshmukh, *Microcontrollers : Theory and Application*, TMH, 2005

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2002 MODERN POWER CONVERTER

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To equip students with various advanced topics in power electronics

Learning Outcomes

Upon successful completion of this course, students will be able to understand working of power converters and design converters for industrial applications

Module I

Introduction to switched mode power converters, Generalized comparison between switched mode and linear DC regulators, operation and steady state performance of Buck, Boost, Buck-Boost and Cuk Converters: Continuous conduction mode, discontinuous conduction mode and boundary between continuous and discontinuous mode of operation, output voltage ripple calculation, effect of parasitic elements.

Module II

DC-DC converter with isolation: Fly back converters- other fly back converter topologies, forward converter, The forward converter switching transistor- Variation of the basic forward converter, Push pull converter-Push pull converter transistor-Limitation of the Push Pull circuit-circuit variation of the push pull converter-the half bridge and full bridge DC-DC converters. High frequency inductor design and transformer design considerations, magnetic core, current transformers.

Module III

Control of switched mode DC power supplies: Voltage feed forward PWM control, current mode control, digital pulse width modulation control, isolation techniques of switching regulator systems: soft start in switching power supply designs, current limit circuits, over voltage protection circuit. A typical monolithic PWM control circuit and their application: TL 494. Power factor control in DC-DC converters. Electromagnetic and radio frequency interference, conducted and radiated noise, EMI suppression, EMI reduction at source, EMI filters, EMI screening, EMI measurements and specifications. Power conditioners and Uninterruptible Power Supplies, Types of UPS-Redundant and Non Redundant UPS.

References

1. Mohan, Undeland, Robbins, *Power Electronics: Converters, Application and Design*, John Wiley & Sons, 1989
2. A. I. Pressman, *Switching Mode Power Supply Design*, Tata McGraw-Hill, 1992
3. M. H. Rashid, *Power Electronics*, PHI, 2004
4. Michel, D., *DC-DC Switching Regulator Analysis*, Newness, 2000
5. Lee, Y., *Computer Aided Analysis and Design of Switch Mode Power Supply*, 1993
6. Staff, VPEC, *Power Device & their Application*, 2000

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2003 **POWER PLANT INSTRUMENTATION**

Structure of the course

Lecture: 3hrs/week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objective

To equip students with various advanced topics in Power System Instrumentation

Learning Outcomes

Upon successful completion of this course, students will be acquainted to advanced instrumentation techniques employed in power plants.

Module I

General scope of instrumentation in power systems. Electrical instruments and meters. Telemetry. Data transmission channels-pilots, PLCC, Microwave links. Interference effect. Automatic meter reading and billing.

Module II

Simulators. SCADA and operating systems. Data loggers and data display system. Remote control instrumentation. Disturbance recorders. Area and Central Control station instrumentation.

Module III

Frontiers of future power system instrumentation including microprocessor based systems. Application of digital computers for data processing and on-line system control.

References

1. Central Power Research Institute (India),*Power System Instrumentation: National Workshop: Papers*, 1991
2. B.G Liptak, '*Instrumentation in Process Industries'*, CRC, 2010
3. B. Singh, Microprocessor control and instrumentation of electrical power systems, University of Bradford, 1987
4. Bonneville Power Administration, *SCADA: Remote Control For a Power System*, 1995

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2004 **ADVANCED CONTROL SYSTEM DESIGN**

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To understand about the basics of optimal control. To introduce about the current research in optimization for robust control.

Learning Outcomes

Upon successful completion of this course, students will be able to implement control techniques optimally.

Module I

Describing system and evaluating its performance: problem formulation - state variable representation of the system-performance measure-the carrier landing of a jet aircraft-dynamic programming

Module II

Linear quadratic optimal control: formulation of the optimal control problem- quadratic integrals and matrix differential equations-optimum gain matrix –steady state solution-disturbances and reference input: exogenous variables general performance integral –weighting of performance at terminal time, concepts of MIMO system.

Module III

Linear quadratic Gaussian problem : Kalman identity-selection of the optimal LQ performance index-LQR with loop shaping techniques-linear quadratic Gaussian problem-kalman state estimator -property of the LQG based controller-reduced order LQG control law design-advances in control system design-concept of robust control- H infinity design techniques

References

1. Bernad Friedland, *Control System Design*, McGraw-Hill, 2012.
2. Ching-Fang-Lin , *Advanced Control System Design*, Prentice Hall, 1994.
3. Krick D. E., *Optimal Control Theory*, Dover Publications, 2004.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students.

ECD2001 INDUSTRIAL DATA NETWORKS 3-0-0-3

Structure of the course

Credits: 3

Lecture : 3 hrs/week
Internal Assessment : 40 Marks
End semester Examination : 60 Marks

Course objectives

1. To understand the basics of data networks and internetworking
2. To have adequate knowledge in various communication protocols
3. To study the industrial data networks

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Explain and analyse the principles and functionalities of various industrial Communication Protocols
2. Implement and analyse industrial Ethernet and wireless communication modules

Module I

Data Network Fundamentals: Network hierarchy and switching – Open System Interconnection model of ISO– Data link control protocol: - HDLC – Media access protocol – Command/response – Token passing – CSMA/CD, TCP/IP, Bridges – Routers – Gateways – Standard ETHERNET and ARCNET configuration special requirement for networks used for control.

Module II

Hart, Fieldbus, Modbus and Profibus PA/DP/FMS and FF: Introduction- Evolution of signal standard – HART communication protocol – Communication modes - HART networks - HART commands - HART applications. Fieldbus: Introduction - General Fieldbus architecture - Basic requirements of Field bus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC). MODBUS protocol structure - function codes - troubleshooting Profibus: Introduction - profibus protocol stack – profibus communication model - communication objects - system operation - troubleshooting - review of foundation field bus.

Module III

Industrial Ethernet and Wireless Communication: Industrial Ethernet: Introduction - 10Mbps Ethernet, 100Mbps Ethernet. Radio and wireless communication: Introduction - components of radio link - the radio spectrum and frequency allocation - radio modems.

References

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, '*Practical Industrial Data Networks Design, Installation and Troubleshooting*', Newnes publication, Elsevier, First edition, 2004.
2. William Buchanan '*Computer Busses'*, CRC Press, 2000.
3. Andrew S. Tanenbaum, '*Modern Operating Systems*', Prentice Hall India, 2003
4. Theodore S. Rappaport, '*Wireless Communication: Principles & Practice*, 2nd Edition, 2001, Prentice Hall of India
5. Willam Stallings, ' *Wireless Communication & Networks*' 2nd Edition, 2005, Prentice Hall of India

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students.

Industrial Relevance of the Course

There is a serious shortage of industrial data communications and industrial IT engineers, technologists and technicians in the world. Only recently these new technologies have become a key component of modern plants, factories and offices. Businesses throughout the world comment on the difficulty in finding experienced industrial data communications and industrial IT experts, despite paying outstanding salaries. The interface from the traditional SCADA system to the web and SQL databases has also created a new need for expertise in these areas. Specialists in these areas are few and far between. The aim of this course is to provide students with core skills in working with industrial data Communications and industrial IT systems and to take advantage of the growing need by industry.

ECD 2002 PROCESS CONTROL & INDUSTRIAL AUTOMATION 3-0-0-3

Structure of the course

Credits: 3

Lecture : 3 hrs/week
Internal Assessment : 40 Marks
End semester Examination : 60 Marks

Course objectives

1. To provide an insight into process control.
2. To provide knowledge on the role of PID controllers in an industrial background.
3. To give an overview of the different control structures used in process control.
4. To give an in depth knowledge on industrial automation-SCADA and PLC.

Learning Outcomes

Upon successful completion of this course, students will be able to

1. Model a process control system and analyse its performance.
2. Design and tune PID controllers for a system.
3. Recognise the need of each type of control structure used in industry.
4. Write simple ladder programs for simple industrial automation –case study.

Module I

Introduction to process dynamics: Physical examples of first order process-first order systems in series-dynamic behaviour of first and second order systems - Control valves and transmission lines, the dynamics and control of heat exchangers. Level control, flow control, dynamics, Stability and control of chemical reactors, Control modes: on-off, P, PL PD, PID, Controller tuning-Zeigler Nichols self tuning methods.

Module II

Advanced control techniques: Feed forward control, Cascade control. Ratio control. Adaptive control, Override control, Control of nonlinear process. Control of process with delay. Hierarchical control, Internal mode control, Model predictive control. Statistical process control. Digital controllers Effects of sampling-implementation of PID controller-stability and tuning-digital feed forward control.

Module III

Industrial Automation: SCADA Systems, SCADA Architecture: Monolithic, Distributed and Networked. Programmable logic controllers, combinational and sequential logic controllers - System integration with PLCs and computers - PLC application in Industry - distributed control system - PC based control - Programming On /Off Inputs to produce On/Off outputs, Relation of Digital Gate Logic to contact /Coil Logic, PLC programming using Ladder Diagrams from Process control Descriptions, Introduction to IEC 61511/61508 and the safety lifecycle.

References

1. George Stephanopoulos, "*Chemical Process Control*", Prentice-Hall of India
2. Donald R. Coughnour, *'Process System Analysis and Control*", McGraw-Hill, 1991
3. D. E. Seborg, T. F. Edger, *'Process Dynamics and Control'*, John Wiley, 1998
4. Enrique Mandado, Jorge Marcos, Serafin A Perrez, *'Programmable Logic Devices and Logic Controllers'*, Prentice-Hall, 1996
5. Dobrivoje Popovic, Vijay P. Bhatkar, Marcel Dekker, *'Distributed Computer Control for Industrial Automation*", INC, 1990
6. G. Liptak, *'Handbook of Process Control*, 1996
7. Ronald A. Reis, '*Programmable logic Controllers Principles and Applications*', Prentice-Hall of India
8. *Pocket Guide on Industrial Automation for Engineers and Technicians*, Srinivas Medida, IDC Technologies

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students.

ECD2003 SOFT COMPUTING TECHNIQUES 3-0-0-3

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Assessment	: 40 Marks	
End semester Examination	: 60 Marks	

Course objectives

1. To provide concepts of soft computing and design controllers based on ANN and Fuzzy systems.
2. To identify systems using soft computing techniques.
3. To give an exposure to optimization using genetic algorithm.
4. To provide a knowledge on hybrid systems.

Learning Outcomes

Upon successful completion of the course, students will be able to:

1. Design a complete feedback system based on ANN or Fuzzy control.
2. Identify systems using soft computing techniques.
3. Use genetic algorithm to find optimal solution to a given problem.
4. Design systems by judiciously choosing hybrid techniques.

Module I

Neural network: Biological foundations - ANN models - Types of activation function - Introduction to Network architectures -Multi Layer Feed Forward Network (MLFFN) - Radial Basis Function Network (RBFN) - Recurring Neural Network (RNN).

Learning process : Supervised and unsupervised learning - Error-correction learning - Hebbian learning – Boltzmann learning - Single layer and multilayer perceptrons - Least mean square algorithm – Back propagation algorithm - Applications in pattern recognition and other engineering problems Case studies - Identification and control of linear and nonlinear systems.

Module II

Fuzzy sets: Fuzzy set operations - Properties - Membership functions , Fuzzy to crisp conversion, fuzzification and defuzzification methods , applications in engineering problems.

Fuzzy control systems: Introduction - simple fuzzy logic controllers with examples - Special forms of fuzzy logic models, classical fuzzy control problems , inverted pendulum, image processing , home heating system, Adaptive fuzzy systems.

Module III

Genetic Algorithm: Introduction - basic concepts, application.

Hybrid Systems: Adaptive Neuro-fuzzy Inference System (ANFIS), Neuro-Genetic, Fuzzy-Genetic systems. Ant colony optimization, Particle swarm optimization (PSO). Case Studies.

References

1. J. M. Zurada, '*Introduction to Artificial Neural* Systems', Jaico Publishers, 1992.
2. Simon Haykins, '*Neural Networks - A Comprehensive Foundation, Mcmillan College*', Proc., Con., Inc., New York. 1994.
3. D. Driankov. H. Hellendorn, M. Reinfrank, '*Fuzzy Control - An Introduction, Narora Publishing House*', New Delhi, 1993.
4. H. J. Zimmermann, '*Fuzzy Set Theory and its Applications*', 111 Edition, Kluwer Academic Publishers, London.
5. G. J. Klir, Boyuan, '*Fuzzy Sets and Fuzzy Logic*', Prentice Hall of India (P) Ltd, 1997.
6. Stamatios V Kartalopoulos, '*Understanding Neural Networks And Fuzzy Logic Basic Concepts And Applications*', Prentice Hall of India (P) Ltd, New Delhi, 2000.
7. Timothy J. Ross, '*Fuzzy Logic With Engineering Applications*', McGraw Hill, New York.
8. Suran Goonatilake, Sukhdev Khebbal (Eds.), '*Intelligent Hybrid Systems*', John Wiley & Sons, New York, 1995.
9. Vose Michael D., '*Simple Genetic Algorithm - Foundations and Theory*', Prentice Hall of India.
10. Rajasekaran & Pai, '*Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*', Prentice-Hall of India, 2007.
11. J. S. Roger Jang, C. T. Sun and E. Mizutani, '*Neuro Fuzzy and Soft Computing*', Prentice Hall Inc., New Jersey, 1997.

Structure of the Question Paper

For the end semester examination, the question paper consists three questions from each module, out of which two are to be answered by the students.

ECD2004 EMBEDDED SYSTEMS AND REAL TIME APPLICATIONS 3-0-0-3

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Assessment	: 40 Marks	
End semester Examination	: 60 Marks	

Course objectives

1. To equip students for the development of an Embedded System for Control/ Guidance/ Power/Electrical Machines applications.
2. To make students capable of developing their own embedded controller for their applications

Learning outcomes

Upon successful completion of this course, students will be able to design and develop suitable embedded controller for any physical system and implement it in real-time.

Module I

Introduction to Embedded Systems: Embedded system definition, features. Current trends and Challenges, Real-time Systems. Hard and Soft, Predictable and Deterministic kernel, Scheduler. 8051-8 bit Microcontroller: Architecture, CPU Block Diagram, Memory management, Interrupts peripheral and addressing modes. ALP & Embedded C programming for 8051 based system-timer, watch dog timer, Analog & digital interfacing, serial communication. Introduction to TI MSP430 microcontrollers. Architecture, Programming and Case study/Project with popular 8/16/32 bit microcontrollers such as 8051, MSP 430, PIC or AVR.

Module II

High Performance RISC Architecture : ARM Processor Fundamentals, ARM Cortex M3 Architecture, ARM Instruction Set, Thumb Instructions, memory mapping, Registers, and programming model. Optimizing ARM assembly code. Exceptions & Interrupt handling. Introduction to open source development boards with ARM Cortex processors, such as Beagle Board, Panda board & leopard boards. Programming & porting of different OS to open source development boards.

Module III

Real time Operating System: Basic Concepts, Round robin, Round robin with interrupts, Function queue scheduling architecture, semaphores, Mutex, Mail box, memory management, Priority inversion, thread Synchronisation. Review of C-Programming, RTOS Linux & RTLinux Internals, Programming in Linux & RTLinux Configuring & Compiling RTLinux.

References

1. Raj Kamal, "*Embedded Systems*", Tata McGraw-Hill, 2003
2. Shultz T. W., "C and the 8051: Programming for Multitasking", Prentice-Hall, 1993
3. Mazidi, "*The 8051 Microcontrollers & Embedded Systems*", Pearson Education Asia.
4. B. Kanta Rao, "*Embedded Systems*", PHI, 2011
5. Barnett, R. H, "*The 8051 family of Microcontroller*, Prentice Hall, 1995.
6. Ayala K. J., *The 8051 Microcontroller: Architecture, Programming and Applications*, West Publishing, 1991,
7. Stewart J. W., Regents, *The 8051 Microcontroller: Hardware, Software and Interfacing*, , Prentice Hall, 1993
8. Yeralan S., Ahluwalia A. *'Programming and Interfacing the 8051 Microcontroller'*, Addison - Wesley, 1995
9. Andrew Dominic, Chris, *ARM System Developers Guide*, MK Publishers

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students.

ECD2005 BIOMEDICAL INSTRUMENTATION 3-0-0-3

Structure of the course

Credits: 3

Lecture	: 3 hrs/week
Internal Assessment	: 40 Marks
End semester Examination	: 60 Marks

Course objectives

To provide an introduction to the modern Biomedical instruments and systems, features and applications.

Learning outcome

Upon successful completion of this course, students will have insight into operation and maintenance of modern biomedical equipments used in clinical practice.

Module 1

Introduction to the physiology of cardiac, nervous, muscular and respiratory systems. Transducers and Electrodes. Different types of transducers and their selection for biomedical applications, Electrode theory. Different types of electrodes, reference electrodes, hydrogen, calomel, Ag-AgCl, pH electrode, selection criteria of electrodes.

Module II

Measurement of electrical activities in muscles and brain. Electromyography, Electroencephalograph and their interpretation. Cardiovascular measurement. The cardio vascular system, Measurement of blood pressure, sphygmomanometer, blood flow, cardiac output and cardiac rate. Electrocardiography, echo- cardiography, ballisto-cardiography, plethysmography, magnetic and ultrasonic measurement of blood flow.

Module III

Therapeutic Equipment Cardiac pace-makers, defibrillators, machine, diathermy.
Respiratory System Measurement: Respiratory mechanism, measurement of gas volume, flow rate, carbon dioxide and oxygen concentration in inhaled air, respiration controller.
Instrumentation for clinical laboratory - Measurement of pH value of blood, ESR measurements, oxygen and carbon concentration in blood, GSR measurement X-ray and Radio isotopic instrumentation, diagnostic X-ray, CAT, medical use of isotopes. Ultrasonography, MRI.

References

1. R. S. Khandpur, *Handbook of Biomedical Instrumentation*, TMH Publishing Company Ltd., New Delhi.
2. Joseph J. Carr, John M Brown, *Introduction to Biomedical Equipment Technology*, Pearson Education (Singapore) Pvt. Ltd.
3. Leslie Cromwell, "*Biomedical Instrumentation and Measurements*", Prentice Hall India, New Delhi

Prerequisite: Basic knowledge in electronic instrumentation

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students.

EPD 2001 NEW AND RENEWABLE SOURCES OF ENERGY 3-0-0-3

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Assessment	: 40 Marks	
End semester Examination	: 60 Marks	

Learning Outcomes

Upon successful completion of this course, students will be able to design and analyse the performance of small isolated renewable energy sources.

Course Objective

This subject provides sufficient knowledge about the promising new and renewable sources of energy so as to equip students capable of working with projects related to its aim to take up research work in connected areas

Module I

Direct solar energy-The sun as a perennial source of energy; flow of energy in the universe and the cycle of matter in the human ecosystem; direct solar energy utilization; solar thermal applications - water heating systems, space heating and cooling of buildings, solar cooking, solar ponds, solar green houses, solar thermal electric systems; solar photovoltaic power generation; solar production of hydrogen.

Module II

Energy from oceans-Wave energy generation - potential and kinetic energy from waves; wave energy conversion devices; advantages and disadvantages of wave energy- Tidal energy - basic principles; tidal power generation systems; estimation of energy and power; advantages and limitations of tidal power generation- Ocean thermal energy conversion (OTEC); methods of ocean thermal electric power generation Wind energy - basic principles of wind energy conversion; design of windmills; wind data and energy estimation; site selection considerations.

Module III

Classification of small hydro power (SHP) stations; description of basic civil works design considerations; turbines and generators for SHP; advantages and limitations. Biomass and bio-fuels; energy plantation; biogas generation; types of biogas plants; applications of biogas; energy from wastes

Geothermal energy- Origin and nature of geothermal energy; classification of geothermal resources; schematic of geothermal power plants; operational and environmental problems

New energy sources (only brief treatment expected)-Fuel cell: hydrogen energy; alcohol energy; nuclear fusion: cold fusion; power from satellite stations

References

1. John W. Twidell , Anthony D Weir, *'Renewable Energy Resources'* , English Language Book Society (ELBS), 1996
2. Godfrey Boyle , *‘Renewable Energy -Power for Sustainable Future* ,Oxford University Press, 1996
3. S. A. Abbasi, Naseema Abbasi, *'Renewable energy sources and their environmental impact"* Prentice-Hall of India, 2001
4. G. D. Rai, *'Non-conventional sources of energy'*, Khanna Publishers, 2000
5. G. D. Rai, *'Solar energy utilization*', Khanna Publishers, 2000
6. S. L. Sah, *'Renewable and novel energy sources'*, M.I. Publications, 1995
7. S. Rao and B. B. Parulekar, *'Energy Technology*', Khanna Publishers, 1999

Structure of the question paper

For the end semester examination, the question paper contains three questions from each module out of which two questions are to be answered by the student.

EPD 2002 SCADA SYSTEMS AND APPLICATIONS

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Assessment	: 40 Marks	
End semester Examination	: 60 Marks	

Course Objective

To introduce SCADA systems, its components, architecture, communication and applications.

Learning Outcomes

Upon successful completion of this course, students will be able to use SCADA systems in different engineering applications such as utility, communication, automation, control, monitoring etc.

Module I

Introduction to SCADA Data acquisition systems - Evolution of SCADA, Communication technologies-. Monitoring and supervisory functions- SCADA applications in Utility Automation, Industries- SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED),Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

Module II

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850-SCADA Communication:Various industrial communication technologies -wired and wireless methods and fibre optics-Open standard communication protocols

Module3

SCADA Applications: Utility applications- Transmission and Distribution sector -operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation. Simulation Exercises

References

1. Stuart A Boyer. *SCADA-Supervisory Control and Data Acquisition*', Instrument Society of America Publications. USA. 1999.
2. Gordan Clarke, Deon RzynAzvs, *Practical Modern SCADA Protocols:* DNP3, 60870J and Related Systems', Newnes Publications, Oxford, UK,2004

Structure of the question paper

For the end semester examination, the question paper contains three questions from each module out of which two questions are to be answered by the student.

EMD2001 ELECTRIC AND HYBRID VEHICLES 3-0-0-3

Structure of the course

Credits: 3

Lecture	: 3 hrs/week
Internal Assessment	: 40 Marks
End semester Examination	: 60 Marks

Course Objective

To present a comprehensive overview of Electric and Hybrid Electric Vehicle.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Choose a suitable drive scheme for developing an electric of hybrid vehicle depending on resources.
2. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
3. Choose proper energy storage systems for vehicle applications.
4. Identify various communication protocols and technologies used in vehicle networks.

Module I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Module II

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology,

Module III

Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

References

1. Iqbal Hussein, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, *Modern Electric*, *Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press, 2004.
3. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003.

(The course syllabus is as presented in NPTEL, IIT-M. The online resources in the NPTEL library may be utilised for this course).

Structure of the question paper

For the end semester examination, the question paper contains three questions from each module out of which two questions are to be answered by the student.

EDD2001 POWER ELECTRONICS SYSTEM DESIGN USING ICs 3-0-0-3

Structure of the Course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

1. To learn about specialized IC's and its applications
2. To understand PLL design and its applications
3. To study basics of PLCs

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Understand analog and digital system design concepts
2. Learn the specifications and applications of PWM control ICs.
3. Learn about self-biased techniques used in power supplies
4. Obtain information about different special purpose ICs and their applications

Module I

Introduction: Measurement Techniques for Voltages, Current, Power, power factor in Power Electronic circuits, other recording and analysis of waveforms, sensing of speed.
Phase – Locked Loops (PLL) & Applications: PLL Design using ICs, 555 Timer & its applications, Analog to Digital converter using ICs, Digital to Analog converters using ICs, implementation of different gating circuits.

Module II

Switching Regulator Control Circuits: Introduction, Isolation Techniques of switching regulator systems, PWM Systems, Some commercially available PWM control ICs and their applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 Resonant mode power supply controller.
Switching Power Supply Ancillary, Supervisory & Peripheral circuits and components: Introduction, Optocouplers, self-Biased techniques used in primary side of reference power supplies, Soft/Start in switching power supplies, Current limit circuits, Over voltage protection, AC line loss detection.

Module III

Programmable Logic Controllers (PLC): Basic configuration of a PLC, Programming and PLC, Program Modification, Power Converter control using PLCs.

References

1. G. K. Dubey, S. R. Doradla, A. Johsi, and R. M. K. Sinha, *Thyristorised Power Controllers*, New Age International, 1st Edition, 2004.
2. George Chryssis, *High Frequency Switching Power Supplies*, McGraw-Hill, 2nd Edition,
3. Unitrode application notes: http://www.smps.us/Unitrode.html

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students

EDD2002 ENERGY AUDITING CONSERVATION AND MANAGEMENT 3-0-0-3

Structure of the Course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

Understanding, analysis and application of electrical energy management measurement and accounting techniques, consumption patterns, conservation methods.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. To understand the concept of analysis and application of electrical energy management measurement techniques.
2. To understand the various energy conservation methods in industries.

Module I

Energy Auditing and Economics: System approach and End use approach to efficient use of Electricity; Electricity tariff types; Energy auditing-Types and objectives-audit instruments – ECO assessment and Economic methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, profitability index, life cycle costing approach, investment decision and uncertainty, consideration of income taxes, depreciation and inflation in investment analysis-specific energy analysis-Minimum energy paths- consumption models- Case study.

Module II

Reactive Power Management and Lighting: Reactive Power management –Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance-Case study. Economics of power factor improvement. Peak Demand controls- Methodologies –Types of Industrial Loads-Optimal Load scheduling-Case study. Lightning-Energy efficient light sources-Energy Conservation in Lighting schemes. Electronic Ballast-Power quality issues-Luminaries-Case study.

Module III

Cogeneration and conservation in industries: Cogeneration-Types and Schemes-Optimal operation of cogeneration plants- Case study. Electric loads of Air conditioning and Refrigeration –Energy conservation measures-Cool storage- Types- Optimal operation-Case study .Electric water heating-Geysers-Solar Water Heaters-Power Consumption in Compressors, Energy conservation measures-Electrolytic Process-Computer Control-Software –EMS.

References

1. Giovanni Petrecca, *Industrial Energy Management: Principles and Application*, The Kluwer International Series-207, 1999
2. Anthony J. Pansini, Kenneth D. Smalling, *Guide to Electric Load Management*, Pennwell Pub.,1998
3. Howard E. Jordan, *Energy-Efficient Electric Motors and their Applications*, Pleneum Pub Corp. 2^{nd} edition, 1994
4. Turner, Wayne C., *Energy Management Handbook*, Lilburn, The Fairmont Press, 2001.
5. Albert Thumann, *Handbook of Energy Audits*, Fairmont Press 5^{th} Edition, 1998
6. IEEE Bronze Book, *Recommended Practice for Energy Conservation and Cost effective Planning in Industrial Facilities* ,IEEE Inc ,USA
7. Albert Thumann P.W, *Plant Engineers and Managers Guide to Energy Conservation*, 7^{th} Edition, TWI Press Inc. Terre Haute.
8. Donald R. W., *Energy Efficiency Manual*, Energy Institute Press
9. Partab H., *Art and Science of Utilization of Electrical Energy*, Dhanpat Rai & Sons , New Delhi
10. Tripathy S. C., *Electrical Energy Utilization and Conservation*, Tata McGraw-Hill
11. NESCAP- *Guide Book on Promotion of Sustainable Energy Consumption*

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students

EDD 2003 ADVANCED POWER SYSTEM ANALYSIS 3-0-0-3

Prerequisites: Basic Course in Power System Engineering

Structure of the Course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

1. At the end of the course students will be able to perform analysis power network systems.
2. Should be able to analyze faults and load flows
3. Can develop programming skills for coding load flows and its applications like OPF.
4. Ability to understand concepts for solving multi phase systems.

Learning Outcomes

Upon successful completion of this course, students will be able to use various algorithms for solving a real time power system network.

Module I

Basics of graph theory-incidence matrices-Primitive network- Building algorithm for formation of bus impedance matrix (Z_{BUS})--Modification of Z_{BUS} due to changes in the primitive network with and without mutual coupling. Review of Y_{BUS} formation-Modification of Z_{BUS} and Y_{BUS} for change of reference.

Network fault Calculations: Review of sequence transformations and impedance diagrams- Fault calculations using Z_{BUS}, Analysis of balanced and unbalanced three phase faults –Short circuit faults – open circuit faults.

Module II

Network modelling – Conditioning of Y Matrix – Load Flow basics- Newton Raphson method– Fast decoupled Load flow –Three phase load flow.

Review of HVDC systems- DC power flow – Single phase and three phase

Need for AC-DC systems- AC-DC load flow – DC system model – Unified and Sequential Solution Techniques.

Module III

Review of economic dispatch**:** strategy for two generator system – generalized strategies – effect of transmission losses. Combined economic and emission dispatch- Reactive power dispatch-Formulation of optimal power flow (OPF) – various equality and inequality constraints -solution by Gradient method – Newton's method – Security constrained OPF- Sensitivity factors - Continuation Power flow method.

References

1. G. W. Stagg and El-Abiad, *Computer Methods in Power System Analysis*, McGraw-Hill, 1968.
2. Arrillaga J., and Arnold C.P., '*Computer Analysis of Power Systems*', John Wiley and Sons, New York, 1997
3. Allen J. Wood and Bruce F. Woollenberg, '*Power Generation Operation and Control*', John Wiley & Sons, 2nd Edition 1996.
4. D.P. Kothari, J.S. Dhillon, '*Power System Optimization*', Prentice-Hall India Pvt. Ltd., New Delhi, 2006
5. Grainger J. J., Stevenson W. D., '*Power System Analysis*', Tata McGraw-Hill, New Delhi, 2003
6. Nagrath, D. P. Kothari, "*Modern Power System Analysis*", Tata McGraw-Hill, 1980
7. Pai M.A., '*Computer Techniques in Power System Analysis*', 2nd edition, Tata McGraw-Hill, New Delhi, 2006.
8. Ajjarapu V., Christy C., "*The Continuation Power Flow: A Tool for Voltage Stability Analysis*", IEEE Transactions on Power Systems, Vol. 7(1), pp 416-423.

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students

EDD2004 INDUSTRIAL AUTOMATION TOOLS 3-0-0-3

Prerequisite: Basic knowledge in electrical engineering, Control Systems.

Structure of the Course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

1. To introduce students to the use of PLCs in industry and to provide skills with modern PLC programming tools.
2. To acquire basic knowledge about multi-input multi-output (MIMO) systems.
3. To acquire extensive basic and advanced knowledge about various aspects of PLC, SCADA, DCS and Real Time Systems.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Understand the operation of a PLC (Programmable Logic Controller) and its use in industry.
2. Hardwire a PLC and apply ladder logic programming to perform simple automation tasks.
3. Understand and apply common industrial analogue and digital input/output modules.
4. Demonstrate an understanding of field bus systems and SCADA at an introductory level.

Module I

Multivariable control- Basic expressions for MIMO systems- Singular values- Stability norms-Calculation of system norms- Robustness- Robust stability.
H_2/H_∞ Theory- Solution for design using H_2/H_∞ - Case studies. Interaction and decoupling-Relative gain analysis- Effects of interaction- Response to disturbances- Decoupling-Introduction to batch process control.
PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules. PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils, Drill press operation.

Module II

Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.
Large Scale Control Systems - SCADA: Introduction, SCADA Architecture, Different Communication Protocols, Common System Components, Supervision and Control, HMI, RTU and Supervisory Stations, Trends in SCADA, Security Issues

Module III

Distributed Control Systems (DCS): Introduction, DCS Architecture, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, and redundancy concept - case studies in DCS.
Real time systems- Real time specifications and design techniques- Real time kernels- Inter task communication and synchronization- Real time memory management- Supervisory control- direct digital control- Distributed control- PC based automation.

References

1. Shinskey F.G., *Process Control Systems: Application, Design and Tuning*, McGraw Hill International Edition, Singapore, 1988.
2. Belanger P.R., *Control Engineering: A Modern Approach*, Saunders College Publishing, USA, 1995.
3. Dorf R. C. and Bishop R. T., *Modern Control Systems*, Addison Wesley Longman Inc., 1999
4. Laplante P.A., *Real Time Systems: An Engineer's Handbook*, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
5. Stuart A. Boyer: *SCADA-Supervisory Control and Data Acquisition*, Instrument Society of America Publications,USA,1999
6. Efim Rosenwasser, Bernhard P. Lampe, *Multivariable Computer-Controlled Systems*: *A Transfer Function Approach,* Springer, 2006
7. John W. Webb, Ronald A. Reiss, *Programmable Logic Controllers: Principle and Applications*, Fifth Edition, PHI
8. R. Hackworth and F.D Hackworth Jr., *Programmable Logic Controllers: Programming Method and Applications*, Pearson, 2004.

Structure of the Question Paper

For the end semester examination, the question paper consists of three questions from each module, out of which two are to be answered by the students.

EID2001 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide experience to design digital and analog hardware interface for microcontroller based systems. To provide in depth knowledge of higher bit processors

Learning Outcomes

Upon successful completion of this course, students will be able to use microprocessors and microcontrollers for different applications.

Module I

Internal architecture of 8086 CPU, instruction set and programming, assembly language programming on IBM PC, ROM bios and DOS utilities. 8086 basic system concepts, signals, instruction queue, MIN mode and MAX mode, bus cycle, memory interface, read and write bus cycles, timing parameters.

Module II

Input/output interface of 8086, I/O data transfer, I/O bus cycle. Interrupt interface of 8086, types of interrupts, interrupt processing. DMA transfer, interfacing and refreshing DRAM, 8086 based multiprocessing system, 8087 math coprocessor. Typical 8086 based system configuration, keyboard interface, CRT controller, floppy disk controller

Module III

Introduction to higher bit processors, 80286, 80386, 80486, Pentium. A typical 16 bit Microcontroller with RISC architecture and Integrated A-D converter e.g. PIC 18Cxxx family: Advantages of Harvard Architecture, instruction pipeline, analog input, PWM output, serial I/O, timers, in-circuit and self programmability. Instruction set. Typical application. Development tools.

References

1. Ray A. K., Bhurchandi K. M., *Advanced Microprocessor and Peripherals, Architecture, Programming and Interfacing*, TMH, 2006
2. Hall D.V., *Microprocessor & Interfacing – Programming & Hardware – 8086, 80286, 80386, 80486*', TMH, 1992
3. Rajasree Y., *Advanced Microprocessor*, New Age International Publishers, 2008
4. Brey B. B. '*The Intel Microprocessor 8086/8088, Pentium , Pentium Processor,* PHI, 2008
5. Ayala K. J., *The 8086 Microprocessor*, Thomson Delmar Learning, 2004.
6. Cady F. M., *Microcontrollers & Microcomputers Principles of Software &Hardware Engineering,* Oxford University Press, 1997
7. Tabak D., *Advanced Microprocessors*,TMH, 1996
8. Deshmukh, *Microcontrollers : Theory and Application*, TMH, 2005

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2002 MODERN POWER CONVERTER

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To equip students with various advanced topics in power electronics

Learning Outcomes

Upon successful completion of this course, students will be able to understand working of power converters and design converters for industrial applications

Module I

Introduction to switched mode power converters, Generalized comparison between switched mode and linear DC regulators, operation and steady state performance of Buck, Boost, Buck-Boost and Cuk Converters: Continuous conduction mode, discontinuous conduction mode and boundary between continuous and discontinuous mode of operation, output voltage ripple calculation, effect of parasitic elements.

Module II

DC-DC converter with isolation: Fly back converters- other fly back converter topologies, forward converter, The forward converter switching transistor- Variation of the basic forward converter, Push pull converter-Push pull converter transistor-Limitation of the Push Pull circuit-circuit variation of the push pull converter-the half bridge and full bridge DC-DC converters. High frequency inductor design and transformer design considerations, magnetic core, current transformers.

Module III

Control of switched mode DC power supplies: Voltage feed forward PWM control, current mode control, digital pulse width modulation control, isolation techniques of switching regulator systems: soft start in switching power supply designs, current limit circuits, over voltage protection circuit. A typical monolithic PWM control circuit and their application: TL 494. Power factor control in DC-DC converters. Electromagnetic and radio frequency interference, conducted and radiated noise, EMI suppression, EMI reduction at source, EMI filters, EMI screening, EMI measurements and specifications. Power conditioners and Uninterruptible Power Supplies, Types of UPS-Redundant and Non Redundant UPS.

References

1. Mohan, Undeland, Robbins, *Power Electronics: Converters, Application and Design*, John Wiley & Sons, 1989
2. A.I. Pressman, *Switching Mode Power Supply Design*, Tata McGraw-Hill, 1992
3. M. H. Rashid, *Power Electronics*, PHI, 2004
4. Michel, D., *DC-DC Switching Regulator Analysis*, Newness, 2000
5. Lee, Y., *Computer Aided Analysis and Design of Switch Mode Power Supply*, 1993
6. Staff, VPEC, *Power Device & their Application*, 2000

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2003 **POWER PLANT INSTRUMENTATION**

Structure of the course

Lecture: 3hrs/week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objective

To equip students with various advanced topics in Power System Instrumentation

Learning Outcomes

Upon successful completion of this course, students will be acquainted to advanced instrumentation techniques employed in power plants.

Module I

General scope of instrumentation in power systems. Electrical instruments and meters. Telemetry. Data transmission channels-pilots, PLCC, Microwave links. Interference effect. Automatic meter reading and billing.

Module II

Simulators. SCADA and operating systems. Data loggers and data display system. Remote control instrumentation. Disturbance recorders. Area and Central Control station instrumentation.

Module III

Frontiers of future power system instrumentation including microprocessor based systems. Application of digital computers for data processing and on-line system control.

References

1. Central Power Research Institute (India),*Power System Instrumentation: National Workshop: Papers*, 1991
2. B.G Liptak, '*Instrumentation in Process Industries*', CRC, 2010
3. B. Singh, Microprocessor control and instrumentation of electrical power systems, University of Bradford, 1987
4. Bonneville Power Administration, *SCADA: Remote Control For a Power System*, 1995

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EID2004 **ADVANCED CONTROL SYSTEM DESIGN**

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To understand about the basics of optimal control. To introduce about the current research in optimization for robust control.

Learning Outcomes

Upon successful completion of this course, students will be able to implement control techniques optimally.

Module I

Describing system and evaluating its performance: problem formulation - state variable representation of the system-performance measure-the carrier landing of a jet aircraft-dynamic programming

Module II

Linear quadratic optimal control: formulation of the optimal control problem- quadratic integrals and matrix differential equations-optimum gain matrix –steady state solution-disturbances and reference input: exogenous variables general performance integral –weighting of performance at terminal time, concepts of MIMO system.

Module III

Linear quadratic Gaussian problem : Kalman identity-selection of the optimal LQ performance index-LQR with loop shaping techniques-linear quadratic Gaussian problem-kalman state estimator -property of the LQG based controller-reduced order LQG control law design-advances in control system design-concept of robust control- H infinity design techniques

References

1. Bernad Friedland, *Control System Design*, McGraw-Hill, 2012.
2. Ching-Fang-Lin , *Advanced Control System Design*, Prentice Hall, 1994.
3. Krick D. E., *Optimal Control Theory,* Dover Publications, 2004.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students.

EID2005 MULTIVARIABLE CONTROL THEORY

Structure of the course

Lecture : 3hrs /week Credits: 3
Internal Assessment : 40 Marks.
End semester Examination : 60 Marks.

Course objectives

1. To introduce the concepts of linear and nonlinear multivariable systems.
2. To impart an in-depth knowledge on the different representations of MIMO systems.
3. To provide the difference between linear single and multivariable systems using time and frequency domain techniques and their design.
4. To provide an insight into nonlinear MIMO systems.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Use different representations for MIMO systems.
2. Analyse given linear and non linear multivariable systems and assess its performance using frequency and time domain techniques.
3. Design linear MIMO systems.

Module I

Linear Multivariable Control Systems: Canonical representations and stability analysis of linear MIMO systems, General linear square MIMO systems ,Transfer matrices of general MIMO systems , MIMO system zeros and poles, Spectral representation of transfer matrices: characteristic transfer functions and canonical basis, Representation of the open-loop and closed MIMO system via the similarity transformation and dyads, Stability analysis of general MIMO systems, Singular value decomposition of transfer matrices, Uniform MIMO systems, Characteristic transfer functions and canonical representations of uniform MIMO systems, Stability analysis of uniform MIMO systems, Normal MIMO systems, Canonical representations of normal MIMO systems.

Circulant MIMO systems, Anticirculant MIMO systems, Characteristic transfer functions of complex circulant and anticirculant systems, Multivariable root loci , Root loci of general MIMO systems, Root loci of uniform systems , Root loci of circulant and anticirculant systems.

Module II

Performance and design of linear MIMO systems: Generalized frequency response characteristics and accuracy of linear, MIMO systems under sinusoidal inputs, Frequency characteristics of general MIMO systems, Frequency characteristics and oscillation index of normal MIMO systems, Frequency characteristics and oscillation index of uniform MIMO systems, Dynamical accuracy of MIMO systems under slowly changing deterministic signals, Matrices of error coefficients of general MIMO systems.

Dynamical accuracy of circulant, anticirculant and uniform MIMO systems, Accuracy of MIMO systems with rigid cross-connections , Statistical accuracy of linear MIMO systems, Accuracy of general MIMO systems under stationary stochastic signals, Statistical accuracy of normal MIMO systems ,Statistical accuracy of uniform MIMO systems, Formulae for mean square outputs of characteristic systems , Design of linear MIMO systems

Module III

Nonlinear Multivariable Control System: Study of one-frequency self-oscillation in nonlinear harmonically linearized MIMO systems, Mathematical foundations of the harmonic linearization method for one-frequency periodical processes in nonlinear MIMO systems, One-frequency limit cycles in general MIMO systems, Necessary conditions for the existence and investigation of the limit cycle in harmonically linearized MIMO systems, Stability of the limit cycle in MIMO systems, Limit cycles in uniform MIMO systems, Necessary conditions for the existence and investigation of limit cycles in uniform MIMO systems, Analysis of the stability of limit cycles in uniform systems.

Limit cycles in circulant and anticirculant MIMO systems, Necessary conditions for the existence and investigation of limit cycles in circulant and anticirculant systems, Limit cycles in uniform circulant and anticirculant systems.

References

1. Oleg N. Gasparyan, *Linear and Nonlinear Multivariable Feedback Control: A Classical Approach*, John Wiley & Sons Ltd.,2008.
2. Sigurd Skogestad, Ian Postlethwaite, *Multivariable Feedback Control - Analysis and Design*, John Wiley & Sons Ltd., 2nd Edition, 2005.

Structure of the Question Paper

For the end semester examination, there will be three questions from each module out of which two questions are to be answered by the students.

ECC2000 RESEARCH METHODOLOGY 2-0-0-2

Structure of the course

Credits: 2

Lecture	: 2 hrs/week
Internal Assessment	: 40 Marks
End semester Examination	: 60 Marks

Course Objective

1. To formulate a viable research question
2. To distinguish probabilistic from deterministic explanations
3. To analyze the benefits and drawbacks of different methodologies
4. To understand how to prepare and execute a feasible research project

Learning Outcomes

Upon successful completion of this course, students will be able to understand research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing research papers/thesis/dissertation.

Module I

Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods *vs.* Methodology. Type of research: Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, and Conceptual *vs.* Empirical.
Research Formulation - Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents. Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis. (15 Hours)

Module II

Research design and methods: Research design - Basic Principles- Need for research design — Features of a good design. Important concepts relating to research design: Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction. Development of Models and research plans: Exploration, Description, Diagnosis, Experimentation and sample designs. Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection - Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-Testing -Generalization and Interpretation. (15 Hours)

Module III

Reporting and thesis writing - Structure and components of scientific reports -Types of report - Technical reports and thesis - Significance - Different steps in the preparation, Layout, structure and Language of typical reports, Illustrations and tables, Bibliography, referencing and footnotes. Presentation; Oral presentation - Planning - Preparation -Practice - Making presentation - Use of audio-visual aids - Importance of effective communication.
Application of results of research outcome: Environmental impacts –Professional ethics - Ethical issues -ethical committees. Commercialization of the work - Copy right - royalty - Intellectual property rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

References

1. C. R. Kothari, *Research Methodology*, Sultan Chand & Sons, New Delhi,1990
2. Panneerselvam, *Research Methodology*, Prentice Hall of India, New Delhi, 2012.
3. J. W. Bames, *Statistical Analysis for Engineers and Scientists*, Tata McGraw-Hill, New York.
4. Donald Cooper, *Business Research Methods*, Tata McGraw-Hill, New Delhi.
5. Leedy P. D., *Practical Research: Planning and Design*, McMillan Publishing Co.
6. Day R. A., *How to Write and Publish a Scientific Paper*, Cambridge University Press, 1989.
7. Manna, Chakraborti, *Values and Ethics in Business Profession*, Prentice Hall of India, New Delhi, 2012.
8. Sople, *Managing Intellectual Property: The Strategic Imperative*, Prentice Hall of India, New Delhi, 2012.

EIC2101 INSTRUMENTATION AND CONTROL LAB - II

Structure of the Course

Practical	: 2 hrs/week	Credits : 1
Internal Continuous Assessment	: 100 Marks	

Course Objective

Familiarizing the students about the software tools for control and instrumentation system Design (Labview) .

Learning Outcomes

Get exposure to practical aspects of Control and Instrumentation system Design.

Experiments

1. Use of Essential Software tools for Control and Instrumentation system Design (Labview)
2. Design of Ladder Logic for various practical applications
3. Execution of the Ladders using PLC.

EDC2102 SEMINAR

Structure of the Course

Duration	: 2 hrs/week	Credits : 2
Continuous Assessment	: 100 Marks	

The student is expected to present a seminar in one of the current topics in the stream of specialization. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Distribution of marks

Seminar Report Evaluation	- 50 marks
Seminar Presentation	- 50 marks

EIC2103 THESIS PRELIMINARY: PART-I

Structure of the Course

Thesis	: 2 hrs/week	Credits : 2
Internal Continuous Assessment	: 100 Marks	

For the Thesis-Preliminary Part I the student is expected to start the preliminary background studies towards the Thesis by conducting a literature survey in the relevant field. He/she should broadly identify the area of the Thesis work, familiarize with the design and analysis tools required for the Thesis work and plan the experimental platform, if any, required for Thesis work. The student will submit a detailed report of these activities at the end of the semester.

Distribution of marks

Internal assessment of work by the Guide	: 50 marks
Internal evaluation by the Committee	: 50 Marks

EIE3002 ADVANCED DIGITAL SYSTEM DESIGN

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To acquaint the students with the advanced topics in the Digital Systems

Learning Outcomes

Upon successful completion of this course, students will be able to design digital systems

Module I

Sequential circuit design-Analysis of Clocked Synchronous Sequential Networks (CSSN) - Modeling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization. Asynchronous sequential circuit design-Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment – Problem and the Transition Table

Module II

Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits. Fault diagnosis and testability algorithms Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA's – Fault in PLA – Test Gen– Masking Cycle – DFT Schemes – Built-in Self Test. Synchronous design using programmable devices -EPROM to Realize a Sequential Circuit-Programmable Logic Devices – Designing a Synchronous Sequential Circuit using a GAL – EPROM

Module III

Realization State machine using PLD – FPGA – Xilinx FPGA – Xilinx 2000 - Xilinx 3000 system design using VHDL. VHDL Description of Combinational Circuits – Arrays – VHDL Operators – Compilation and Simulation of VHDL Code – Modeling using VHDL – Flip Flops - Registers – Counters – Sequential Machine – Combinational Logic Circuits - VHDL Code for-Serial Adder, Binary Multiplier – Binary Divider – complete Sequential Systems – Design of a Simple Microprocessor.

References

1. Donald G. Givone, '*Digital Principles and Design'*, Tata McGraw-Hill, 2002
2. John M Yarbrough, '*Digital Logic Applications and Design'*, Thomson Learning, 2001
3. Nripendra N. Biswas, '*Logic Design Theory'* Prentice Hall of India, 2001
4. Charles H. Roth Jr. '*Digital System Design using VHDL'*, Thomson Learning, 1998.
5. Charles H. Roth Jr. "*Fundamentals of Logic Design*" Thomson Learning, 2004.
6. Stephen Brown and Zvonk Vranesic "*Fundamentals of Digital Logic with VHDL Design*", Tata McGraw-Hill, 2002.
7. Navabi.Z. "*VHDL Analysis and Modelling of Digital Systems*", McGraw International, 1998.
8. Parag K Lala, '*Digital System Design using PLD'*, BS Publications, 2003
9. Peter J Ashendem, '*The Designers Guide to VHDL'*, Harcourt India Pvt. Ltd, 2002
10. Mark Zwolinski, '*Digital System Design with VHDL'* Pearson Education, 2004
11. Skahill. K, '*VHDL for Programmable Logic'*, Pearson Education, 1996.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3003 CAD FOR DIGITAL CONTROL

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To acquaint the students with CAD for control systems.

Learning Outcomes

Upon successful completion of this course, students will be able to use CAD for control systems.

Module I

CAD for control design applications – Features of existing CACSD software packages: CC, MATLAB, Control C. State space. Pole placement procedure for controller and observer, design for regulator and tracking systems.

Module II

Discrete time systems, Alternative design approaches: Digital filters, transform methods, Integral control, least squares and maximum likelihood methods for parametric Identification.

Module III

Optimal control: LQR and LQG designs, Kalman filter, Quantization effects, sample rate selection, representative applications.

References

3. Franklin G.F, Rowell J.D and Workmars M.L., Digital Control of Dynamic Systems, 2nd Edition, Addison-Wesley, 1980.
4. Leigh J.R: Applied Digital Control, Prentice Hall, 1985.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3004 **OPTIMAL CONTROL SYSTEMS**

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

The course ensures a thorough knowledge-on various classical methods of design and analysis of optimal control systems.

Learning Outcomes

Upon successful completion of this course, students will have in depth knowledge about optimal control systems control and analysis.

Module I

Basic mathematical concepts: Finite dimensional optimization, Infinite dimensional optimization, Conditions for optimality, Performance measures for optimal control problems, Dynamic programming: The optimal control law, The principle of optimality, Dynamic programming concept, Recurrence relation, computational procedure, The Hamilton-Jacobi-Bellman equations. Calculus of variations: Examples of variational problems, Basic calculus of variations problem, Weak and strong extrema, Variable end point problems, Hamiltonian formalism and mechanics: Hamilton's canonical equations. From Calculus of variations to Optimal control: Necessary conditions for strong extrema, Calculus of variations versus optimal control, optimal control problem formulation and assumptions, Variational approach to the fixed time, free end point problem.

Module II

The Pontryagin's Minimum principle: Statement of Minimum principle for basic fixed end point and variable end point control problems, Proof of the minimum principle, Properties of the Hamiltonian, Time optimal control problems. The Linear Quadratic Regulator: Finite horizon LQR problem- Candidate optimal feedback law, Ricatti differential equations (RDE), Global existence of solution for the RDE. Infinite horizon LQR problem- Existence and properties of the limit, solution, Closed loop stability. Examples: Minimum energy control of a DC motor, Active suspension with optimal linear state feedback, Frequency shaped LQ Control.

Module III

LQR using output feedback: Output feedback LQR design equations, Closed loop stability, Solution of design equations, example. Linear Quadratic tracking control: Tracking a reference input with compensators of known structure, Tracking by regulator redesign, Command generator tracker, Explicit model following design. Minimum time with constrained input design: Minimum time control of LTI system with constraints on control input, Existence and uniqueness theorems, examples.

References

1. D.E. Kirk, ‘Optimal Control Theory - An Introduction’, Dover Publications, New York, 2004.
2. Alok Sinha, Linear Systems - Optimal and Robust Controls, CRC Press, 2007.
3. Daniel Liberzone, Calculus of variations and Optimal control theory, Princiton University press, 2012
4. Frank L. Lewis, Applied optimal control & Estimation- Digital design and implementation, Prentice Hall and Digital Signal Processing Series, Texas Instruments, 1992
5. Jason L. Speyer, David H. Jacobson, Primer on Optimal Control Theory , SIAM,2010
6. Ben-Asher, Joseph Z, **‘**Optimal Control Theory with Aerospace Applications’**,** American Institute of Aeronautics and Astronautics, 2010
7. MIT course notes on Principles Of Optimal Control, 2008

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3005 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide basic knowledge of instrumentation in petrochemical industries.

Learning Outcomes

Upon successful completion of this course, students will have an idea about petroleum industries, importance of measurement, various processing strategies, and control of the process.

Module I

Petroleum processing: Petroleum exploration – Recovery techniques – Oil – Gas separation - Processing wet gases –Refining of crude oil. Operations in petroleum industry :Thermal cracking – Catalytic cracking – Catalytic reforming – Polymerisation – Alkylation

Module II

Isomerization – Production of ethylene, acetylene and propylene from petroleum. Chemicals from petroleum products :Chemicals from petroleum – Methane derivatives – Acetylene derivatives – Ethylene derivatives –Propylene derivatives – Other products.

Module III

Measurements in petrochemical industry -Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments – Intrinsic safety of Instruments. Control loops in petrochemical industry -Process control in refinery and petrochemical industry – Control of distillation column – Control of catalytic crackers and pyrolysis unit – Automatic control of polyethylene production – Control of vinyl chloride and PVC production.

References

1. A.L. Waddams, '*Chemicals from Petroleum*', Butter and Janner Ltd., 1968.
2. J.G. Balchan, K.I. Mumme, '*Process Control Structures and Applications*', Van Nostrand Reinhold Company, New York, 1988.
3. Austin G.T., '*Shreve's Chemical Process Industries*', McGraw-Hill , Singapore, 1998.
4. B.G Liptak, '*Instrument Engineer's Handbook: Process Measurement and Analysis*', Chilton Book Company, 2003.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3006 INTELLIGENT INSTRUMENTATION

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide an insight theory on intelligent instrumentation systems.

Learning Outcomes

Upon successful completion of this course, students will have an idea about interfacing techniques, ADC, DAC, and Communications of the systems.

Module I

Interface components and techniques: Analog components – amplification/attenuation, waveform generators (IC) logic components – address techniques to interface IC's – logic multiplexing & de-multiplexing, converter control for ADC and DAC channels, Data buffers, noise in signal carriers and reduction methods. Continuous and discrete – signals & systems, errors in signal processing such as quantization, time delay and sample rates in respect of input and output data, basic ideas of skew and filtering, digital computer errors.

Module II

Interface systems & standards: Block diagram of a typical interface between process/plant & digital computer - Signal termination, protection, static signal conditioning and manipulation - Output signal flow. Standard Interface system – serial interface standards – RS232C interface, current loop. Parallel interfaces and buses – BSI interface BS 4421:1969, IEC interface/EEE 488/1975, CMAC (IEEE 583) and MEDIA interface system Communication & networking: Peripheral ideas only)

Module III

Distributed control system – serial computer and equipment connections – communication standards – ISO 7 – layer model – local area networks and access methods. Case studies in instrumentation: Case studies to support the principles and concepts discussed in the previous modules such as

1. Temperature measurement system with microprocessors/computer with specified task requirements.
2. Load weighing in a lift elevator system.
3. Remote monitoring of building services.

References

1. *Instrumentation Reference Book,* B.E. Noltingk (Butterworths), Co. Publishers, 1988 ISBN: 0-408-01562-4.
2. Sol D. Prensky, Richard L. Castellucis, '*Electronic Instrumentation'*, Southern Technical Institute, Georgia 3rd Edition, ISBN: 0-13-251611
3. George C. Barney, *Intelligent Instrumentation - Microprocessor Application in Measurement& Control,* Control system centre UMIST, Manchester, Indian Reprint 1988, ISBN: 0-87692-507-7,
4. A.K. Sawhney, A *Course in Electrical & Electronics Measurements & Instrumentation*, 10th Edition, Dhanpat Rai & Sons, 1993.
5. R.K. Jain, '*Mechanical & Industrial Measurements'*, 1st Edition, Khanna Publishers, 1974
6. Ian. R. Sinclair, '*Sensors & Transducers - A Guide for Technicians'*, ISBN: 0632-02069-5, BSP Professional books, Oxford London Edinburg, 2001
7. Kurt S. Lion, '*Instrumentation in Scientific Research - Electrical Input Transducers'*, McGraw-Hill Book Company, Inc. New York, 1959
8. A.J. Bouwens, '*Digital Instrumentation*', ISBN:0-07-006712-0, McGraw-Hill Book Company, 1984

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3007 OPTICAL INSTRUMENTATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To provide an insight theory on Optoelectronics

Learning Outcomes

Upon successful completion of this course, students will have an idea about various optical devices and their applications.

Module I

Introduction to Electromagnetic field theory, Ray and wave optics, Polarization and Isotropic and an-isotropic media. Opto electronics devices: Sources-LED, Laser, Laser diode, Broadband calibration sources, Detectors-Photodiode-P-N, P-I-N, Photo multiplier tubes and ADP,. Optical fibre as cylindrical wave guide, Optical fibre Characteristics- Application and dispersion, fibre-optic polarizer.

Module II

Broadband thermal detector: Modulators-Intensity, Polarization, Phase, Read out schemes for modulation-Polarimeter, interferometer. Transportation media: Wave-guide theory-Slab wave guide, scalar wave equation .Opto electronic sensors and system as a modulator, bulk modulator, fibre-optic modulator.

Module III

Sensing Principles-Electro-optic and magneto-optic (Polarimetric and Interferrometric), magnetostriction based sensors, Distributed Fibre- Optic sensors-OTDR and OFDR principles in temperature measurement, Fibre –optic Gyro. Holographic measurement and its biomedical applications. Optoelectronic integrated circuits and integrated optic sensor.

References

1. G. Lifante, '*Integrated Photonics: Fundamentals*', John Wiley & Sons, 2003
2. Morris Tischler: '*Optoelectronics: Fiber Optics and Lasers*', A Lab Text Manual, 2nd Edition, McGraw-Hill, 1992.
3. Frederic C. Allard: '*Fiber Optics Handbook for Engineers & Scientists* (Optical & Electrooptical Engineering Series)', McGraw-Hill, 1990.
4. John M. Senior, '*Optical Fiber Communications, Principles & Practice*', 2nd edition, Prentice Hall of India, 1996.
5. Subir Kumar Sarkar, '*Optical Fibers & Fiber Optic Communication Systems*', S. Chand & Co., 2001.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3008 VIRTUAL INSTRUMENTATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To equip students with advanced topics in Virtual Instrumentation.

Learning Outcomes

Upon successful completion of this course, students will have idea about Virtual instruments and their techniques used.

Module I

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software.

Module II

Active X programming VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web. Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Module III

VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

References

1. Gary Johnson, *Lab VIEW Graphical Programming*, 2nd edition, McGraw-Hill, New York, 1997.
2. Lisa K. Wells & Jeffrey Travis, ‘*Lab VIEW for Everyone*’, Prentice Hall, New Jersey, 1997.
3. Kevin James, *PC Interfacing and Data Acquisition: Techniques for Measurement*, Instrumentation and Control, Newness, 2000.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3009 FIBRE OPTICS & LASER INSTRUMENTATION

Structure of the course

Lecture	: 3hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

To equip students with various advanced topics in LASER, Fiber optics in the field of Instrumentation technology.

Learning Outcomes

Upon successful completion of this course, students will be acquainted with optical fibers and lasers, about their types, principles, characteristics and their application in the industry.

Module I

Optical Fibers: Theory and classification of fibre optics-properties-characteristics-merits and demerits. Principles of light propagation through fibers. Fibers –different types-properties. Transmission characteristics of optical fibers. Attenuation, Absorption losses, Scattering losses, Dispersion.

Module II

Laser Fundamentals: Characteristics of lasers. Three and Four level lasers, Properties of laser, Types of Lasers: Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers.

Module III

Industrial application of optical fibers: Fibre optic sensors, Fibre optic instrumentation system, Measurement of pressure, temperature, liquid level, current, voltage. Industrial application of lasers: Measurement of distance, length, velocity, current, voltage. Material processing, laser heating, welding, melting and trimming of materials.

References

1. John & Harry, *Industrial Lasers and their Applications*, McGraw-Hill, 1974
2. Senior J. M., *Optical Fiber Communication Principles and Practice*, Prentice Hal, 2006
3. John F. Read, *Industrial Application of Lasers*, Academic Press, 1997.
4. Keiser G., *Optical Fiber Communication*, McGraw-Hill, 2003
5. Charles K. Kao, *Optical Fiber Systems Technology*, Design & Application, McGraw-Hill, 1982.

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students

EIE3010 AI APPLICATION IN OPTIMISATION

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

The course provides exposure to Artificial Intelligent techniques and its applications in the optimization of Control and Instrumentation systems.

Learning Outcomes

Upon successful completion of this course, students will be acquainted with artificial neural networks, fuzzy systems and various optimisation techniques.

Module I

Review of C, C++, Biological foundations - ANN models - Types of activation functions - Introduction to Network architectures -Multi Layer Feed Forward Network (MLFFN) - Radial Basis Function Network (RBFN). Supervised and unsupervised learning - Error-correction learning - Hebbian learning – Boltzmen learning - Single layer and multilayer perceptron. Back propagation algorithm (BPN) - Applications in pattern recognition and other engineering problems.

Module II

Fuzzy set operations - Properties - Membership functions - Fuzzification and Defuzzification methods - applications in engineering problems. Introduction - simple fuzzy logic controllers with examples - Special forms of fuzzy logic models classical fuzzy control problems – smart cars - image processing – washing machines. Adaptive fuzzy systems - hybrid systems - Adaptive Neuro fuzzy Inference System (ANF1S) controllers

Module III

Optimization- Simulated Annealing- *Genetic Algorithm*-Introduction - basic concepts – application- Evolutionary Algorithm (EA) - Swarm Intelligence- Ant Colony, Artificial Bee Colony, Particle Swarm Optimisation (PSO), and ADPSO. Introduction to other modern optimization techniques from literature - Case Studies.

References

1. J.M. Zurada, '*Introduction to Artificial Neural Systems*', Jaico Publishers, 1992.
2. Simon Haykins, '*Neural Networks - A comprehensive foundation*', McMillan College, Proc, Con., Inc, New York. 1994.
3. D. Driankov. H. Hellendorn, M. Reinfrank, '*Fuzzy Control - An Introduction*', Narora Publishing House, New Delhi, 1993.
4. HJ. Zimmermann, '*Fuzzy Set Theory and its Applications*', 4th Edition, Kluwer Academic Publishers, London, 2001
5. G. J. Klir, Boyuan, *Fuzzy Sets and Fuzzy Logic*, Prentice Hall of India (P) Ltd, 1997.
6. Stamatios V Kartalopoulos, *Understanding Neural Networks And Fuzzy Logic Basic Concepts and Applications*, Prentice Hall of India (P) Ltd, New Delhi, 2000.
7. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, McGraw-Hill, New York, 2009
8. Suran Goonatilake, Sukhdev Khebbal (Eds.), *Intelligent Hybrid Systems*, John Wiley & Sons, New York, 1995.
9. Vose Michael D., *Simple Genetic Algorithm - Foundations And Theory*, Prentice Hall of India, 1999
10. Rajasekaran & Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, Prentice-Hall of India, 2007.
11. J. S. Roger Jang, C. T. Sun, E.Mizutani, '*Neuro Fuzzy and Soft Computing*', Prentice Hall Inc., New Jersey, 1997.
12. S. N. Sivanandam & S. N. Deepa, *Principles of Soft Computing*, John Wiley & Sons 2007.
13. International Journal of Soft Computing Applications (IJSCA), ISSN: 1453-2277, Issue No. 1, 2007
14. International Journal of Advances in Soft Computing and Its Applications (IJASCA), Vol. 1, July 2009, ISSN-2074-8523

Structure of the Question paper

For the end semester examination, the question paper will consist of three questions from each module out of which two questions are to be answered by the students.

EIC3101 THESIS PRELIMINARY: PART II

Structure of the Course

Thesis	: 14 hrs/week	Credits: 5
Internal Continuous Assessment	: 200 Marks	

The main objective of the thesis is to provide an opportunity to each student to do original and independent study and research on the area of specialization. The student is required to explore in depth and develop a subject of his/her own choice, which adds significantly to the body of knowledge existing in the relevant field. The student has to undertake a thesis preliminary work on the stream of specialization during this semester. The fourth semester Thesis shall be an extension of this work in the same area. The student has to present two seminars and submit an interim thesis report. The seminar and report shall be evaluated by the evaluation committee. The first seminar would highlight the topic objectives and methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is presentation of the interim thesis report of the work completed and scope of the work which is to be accomplished in the fourth semester.

Evaluation of marks for the thesis preliminary

Evaluation of the thesis – preliminary work by the guide - 100 marks

Evaluation of the thesis – preliminary by the Evaluation Committee - 100 marks

EIC4101 THESIS

Structure of the Course

Thesis	: 21 hrs/week	Credits: 12
Internal Continuous Assessment	: 300 Marks	
End Semester Examination	: 300 Marks	

The student has to continue the thesis work done in second and third semesters. There would be an interim presentation at the first half of the semester to evaluate the progress of the work and at the end of the semester there would be a pre-Submission seminar before the Evaluation committee for assessing the quality and quantum of work. This would be the qualifying exercise for the students for getting approval from the Department Committee for the submission of Thesis. At least once technical paper is to be prepared for possible publication in Journals/Conferences. The final evaluation of the Thesis would be conducted by the board of examiners constituted by the University including the guide and the external examiner.

Distribution of marks

Internal evaluation of the Thesis work by the Guide : 150 Marks

Internal evaluation of the Thesis by the Evaluation Committee : 150 Marks

Final evaluation of the Thesis Work by the Internal and External Examiners:

[Evaluation of Thesis: 200 marks *+ Viva Voce: 100 marks (**5% of the marks is ear marked for publication in Journal/Conference*)] TOTAL – 300 Marks