KANNUR UNIVERSITY

Faculty of Engineering

Curriculum, Scheme of Examinations and Syllabi for M.Tech. Degree Programme with effect from the Academic Year 2013-2014

M.Tech. in
CONTROL & INSTRUMENTATION

FIRST SEMESTER

Code	Subject	Hrs/Week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
CIE 101	Applied Mathematics in Control Theory	3	-	-	50	3	100	3
CIE 102	Industrial Instrumentation	3	-	-	50	3	100	3
CIE 103	Process Dynamics and Control	3	-	-	50	3	100	3
CIE 104	Modern control Systems	3	-	-	50	3	100	3
CIE 105	Elective I	3	-	-	50	3	100	3
CIE 106	Elective II	3	-	-	50	3	100	3
CIE 107(P)	Industrial Instrumentation Lab	-	-	2	50	3	100	2
CIE 108(P)	Seminar	-	-	2	50	-	-	2
TOTAL		18		4	400	-	700	22

Elective I

CIE 105 (A): Multi Sensor Data Fusion
CIE 105 (B): Soft Computing Techniques
CIE 105 (C): Communication Protocols for Instrumentation
CIE 105 (D): Digital Image Processing
CIE 105 (E): Special Electrical Machines

Elective II

CIE 106 (A): Principles of Robotics
CIE 106 (B): Chemical Process Systems
CIE 106 (C): Control of Electric drives
CIE 106 (D): Micro Electro Mechanical Systems
CIE 106 (E): Advanced Digital Signal Processing

Sessional marks for all the Theory based Subjects

The marks allotted for internal continuous assessment and end-semester university examinations shall be 50 marks and 100 marks respectively with a maximum of 150 marks for each theory subject.
The weightage to award internal assessment marks should be as follows:

Test papers (two tests) : 25 marks
Assignments and/or class performance : 25 marks

SECOND SEMESTER

Code	Subject	Hrs/Week			Sessional Marks	University Examination		Credit
		L	T	P/D		Hrs	Marks	
CIE 201	Biomedical Instrumentation	3	-	-	50	3	100	3
CIE 202	System Identification and Adaptive Control	3	-	-	50	3	100	3
CIE 203	SCADA Systems and Applications	3	-	-	50	3	100	3
CIE 204	Elective III	3	-	-	50	3	100	3
CIE 205	Elective IV	3	-	-	50	3	100	3
CIE 206	Elective V	3	-		50	3	100	3
CIE 207(P)	Process Control Lab	-	-	2	50	3	100	2
CIE 208(P)	Term Paper	-	-	2	50	-	-	2
TOTAL		18		4	400	-	700	22

Elective III

CIE 204(A): Design of Embedded Systems
CIE 204(B): Real Time Operating Systems
CIE 204(C): Probability, Statistics and Stochastic Processes
CIE 204(D): Fibre Optic Communication
CIE 204(E): Advanced Process Control

Elective IV

CIE 205(A): Advanced topics in Non Linear control
CIE 205(B): Speech Signal Processing
CIE 205(C): Bioprocess Instrumentation and Control
CIE 205(D): Digital Control Systems Design
CIE 205(E): Optimal Control Theory

Elective V

CIE 206(A): Energy Auditing & Management
CIE 206(B): Microcontroller based System Design
CIE 206 (C) Research Methodology
CIE 206(D): Piping & Instrumentation
CIE 206(E): Programming with VHDL

THIRD SEMESTER

Code	Subject	Hrs/ Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
CIE 301(P)	Thesis Preliminary			22	200	200	--	--	400	8
	Total			22	200	200			400	8

THESIS PRELIMINARY

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis- Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, 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.

FOURTH SEMESTER

Code	Subject	Hrs/ Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
CIE 401(P)	Thesis			22	200	200	100	100	600	12
	Total			22	200	200	100	100	600	12

Towards the middle of the semester there shall be a pre submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consist of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. The comments of the examiners should be incorporated in the work and at least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation.

CIE 101: APPLIED MATHEMATICS IN CONTROL THEORY

3 hours per week

Advanced Matrix Theory: Eigen-values using QR transformations – Generalized Eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

Linear Programming: Formulation – Graphical Solution – Simplex Method – Two Phase Method – Transportation and Assignment Problems.

One Dimensional Random Variables: Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

Queueing Models: Poisson Process – Markovian queues – Single and Multi Serve r Models – Little‟s formula – Machine Interference Model – Steady State analysis – Self Service queue.

Curve fitting: Method of least squares - Normal equations - Fitting of straight line - Fitting of second degree curve - Correlations and regressions - Curvilinear regression - Multiple regression& multiple correlation.

Computational Methods In Engineering: Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace and Poisson equations – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme – Solution of wave equation.

References

1. Bronson, R., Matrix Operation, Schaum‟s outline series, McGraw Hill, New York, (1989).
2. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi (2002).
3. R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Probability and Statistics for Engineers & Scientists, Asia, 8th Edition, (2007).
4. Donald Gross and Carl M. Harris, Fundamentals of Queueing theory, 2nd edition, John Wiley and Sons, New York (1985).
5. Grewal, B.S., Numerical methods in Engineering and Science, 7th edition, Khanna Publishers, 2000

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 102: INDUSRTRIAL INSTRUMENTATION

3 hours per week

Industrial measurement systems, measurement systems elements, Different types of sensors and transducers for measuring various types of industrial variables: pressure, torque, speed, temperature, flow, level, pH, conductivity, viscosity, humidity and thermal conductivity. Piezo-electric and ultrasonic transducers - application in process and biomedical Instrumentation.

Industrial signal conditioning systems- Design of signal conditioning circuits for various Resistive, Capacitive, Inductive transducers and piezoelectric transducer. Amplifiers – Filters – A/D converters for industrial measurements systems, Smart and intelligent transmitters - Design of transmitters. Calibration and response of industrial instrumentation - standard testing methods and procedures – Generalized performance characteristics – static response characterization – dynamic response characterization

Introduction to EMC, interference coupling mechanism, basics of circuit layout and grounding, concept of interfaces, filtering and shielding. Safety: Introduction, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures – NEMA types, fuses and circuit breakers. Protection methods: Purging, explosion proofing and intrinsic safet

Concept of virtual instrumentation – PC based data acquisition, 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 Graphical User Interface (GUI).

References

1. E. O. Doebelin, Measurement Systems - Application and Design, Fifth Edition,Tata McGraw-Hill International Edition, New York, 2005.
2. Dale E. Seborg, Thomas F. Edgar, Duncan A. Melli Champ, Process Dynamics and Control, Second Edition, Wiley-India, 2011.
3. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, New York, 1997.
4. Curtis D. Johnson, Process Control Instrumentation Technology, Eighth Edition, Prentice Hall, 2011.
5. Noltingk B.E., Instrumentation Reference Book, 2nd Edition, Butterworth Heinemann, 1995.

One Assignment shall be based on virtual instrumentation software (eg. LabVIEW), for creating a virtual instrument (VI) with data acquisition.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 103: PROCESS DYNAMICS AND CONTROL

3 hours per week

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

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

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

Programmable Logic Controllers – ladder diagram, Examples of industrial control systems using PLC.

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

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

TEXT BOOKS:

1. George Stephanopoulos, Chemical Process Control, Prentice Hall of India. 2005
2. Caughanour and Koppel, Process systems analysis and control, Tata McGraw Hill. 1991
3. K. M. Hangos and I. T. Cameron, “Process Modelling and Model Analysis”, Academic Press, 2001.
4. W.L. Luyben, “Process Modelling, Simulation and Control for Chemical Engineers”, 2nd Edn., McGraw Hill Book Co., New York, 1990.
5. W. F. Ramirez, “Computational Methods for Process Simulation”, Butterworths,1995.
6. Curtis D. Johnson, Process Control Instrumentation Technology, Eighth Edition, Prentice Hall, 2011

REFERENCES:

1. Dale E. Seborg, Process Dynamics and Control, John Wiley. 2009
2. Eckman D.P, Automatic process control, Wiley Eastern, 1985.

One Assignment shall be based on Simulation of PLC using suitable software.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 104: MODERN CONTROL SYSTEMS

3 hours per week

Introduction to control systems, properties of signals and systems. Convolution integral, Ordinary differential equation, Transfer function, Pole zero concepts, effect of pole location on performance specification. System models in state space, canonical models, MIMO systems, solution of state equation, stability of systems in state space, Controllability, Observability. State space analysis of discrete-time systems.

Multivariable Control Systems Analysis: Concept of Controllability and Reachability, Observability and Constructability, Controllable and Uncontrollable subspace, Observable and unobservable subspace, Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Popov-Belevitch-Hautustest, Controllability and Observability canonical forms, Stability.

Multivariable Control Systems Design: Linear state variable feedback: The effect of state feedback on controllability and observability, Condition for arbitrary pole placement, Ackermann's formula for pole placement, State observers: Full order state observers and minimum order observers, Study of some physical plant like inverted pendulum for analysis and design.

Non-linear system analysis: Non-linear system behaviour, different methods of linearization, Lyapnov stability criterion. Phase plane analysis, singular points, constructing phase portraits, existence of limit cycle.

Describing function analysis: Fundamentals, assumptions, definitions. Describing functions of common non-linearities. Describing function analysis of non-linear systems. Stability of limit cycles, reliability of describing function analysis

TEXT BOOKS:

1. Brogan W. L, Modern Control theory, Prentice Hall International, New Jersey, 1991.
2. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010
3. Jean-Jacques E. Slotine, Weiping Li, Applied nonlinear control, Prentice Hall Inc., New Jersey, 1991.
4. T. Kailath, Linear Systems, Prentice-Hall, Englewood Cliff's, NJ, 1980

REFRENCES:

1. Skelton R. E, Dynamic System Control and Linear System Analysis and Synthesis, John Wiley and Sons Inc., New Delhi, 1993.
2. Vidyasagar .M, Nonlinear system analysis, Second Edition, Prentice Hall Inc., New Jersey, 1993

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 105 (A): MULTI SENSOR DATA FUSION

3 hours per week

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

Algorithms For Data Fusion: Taxonomy of algorithms for multisensor data fusion. Data association. Identity declaration.

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

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

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

REFERENCES:

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston.
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey,
3. Arthur Gelb, Applied Optimal Estimation, The M.I.T. Press
4. James V. Candy, Signal Processing: The Model Based Approach, McGraw –Hill Book Company, 1987

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 105 (B): SOFT COMPUTING TECHNIQUES

3 hours per week

Introduction to Fuzzy logic: Fuzzy sets- Fuzzy set operations- Fuzzy relations-Cardinality of Fuzzy relations-Operations on Fuzzy relations-Properties of Fuzzy relations-Membership Functions-Features of Membership functions- Fuzzification-Methods of Membership value assignments- Fuzzy rule base- Defuzzification- different methods-Fuzzy logic controller (Block Diagram)

Artificial Neural Networks: Basic concepts-Neural network Architectures-Single layer feed forward network-Multilayer feed forward network-Recurrent Networks-Characteristics of neural networks-Learning methods- Perceptron networks-Back propagation networks-Radial base functionnetwork-Hopfieldnetwork-Kohonen self organizingmaps-ART

Fundamentals of genetic algorithms: Basic concepts- Working principle – Encoding – Different methods – Fitness function – Reproduction-Different methods- Genetic modeling, Inheritance- Crossover mutation-Convergence of genetic algorithm. Principle of genetic programming. Fundamentals of rough sets and chaos theory.

Hybrid systems: Neural network- Fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- Neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propogation network- Fuzzy back propagation networks -Fuzzy logic controlled genetic algorithms.

Applications of Computational Intelligence: Printed Character Recognition – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.

References

1. S. Rajasekharan, G.A.Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, Prentice Hall India, 2003
2. Timothy J Ross, Fuzzy logic with Engineering Applications, McGrawHill,New York.
3. S.Haykins, Neural Networks: A Comprehensive Foundation, Pearson Education.
4. D. E. Goldberg, Genetic Algorithms in Search Optimisation and Machine Learning,

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CIE 105 (C): COMMUNICATION PROTOCOLS FOR INSTRUMENTATION

3 hours per week

Introduction to Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Recent networks.

Introduction to Communication Protocols: Communication basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection.

Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols (RS-232C, RS- 422, RS-485), Ethernet, Modbus, Modbus Plus, Data Highway Plus, Advantages and Limitations of Open networks.

Fieldbus: Fieldbus Trends, Hardware selection, Fieldbus design, Installation, Documentation, Fieldbus advantages and limitations.

HART: Introduction, Design, Installation, calibration, commissioning, Application in Hazardous and Non-Hazardous area.

Foundation Fieldbus & Profibus: Introduction, Design, Calibration, Commissioning, Application in Hazardous and Non-Hazardous area.

Introduction to wireless Protocols: WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave.

References:

1. Noltingk B.E., "*Instrumentation Reference Book*", 2nd Edition, Butterworth Heinemann, 1995.
2. B.G. Liptak, Process software and digital networks, 3rd Edition, CRC press, Florida.
3. Romilly Bowden ,'HART Communications Protocol', (Fisher-Rosemount).

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CIE 105 (D): DIGTAL IMAGE PROCESSING

3 hours per week

Introduction – Steps in image processing systems – Image acquisition – Sampling and Quantization – Pixel relationships – Color fundamentals and models, File formats, Image operations – Arithmetic, Geometric and Morphological.

Image enhancement: Spatial Domain: Gray level Transformations – Histogram processing – Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – DFT, FFT, DCT – Smoothing and sharpening filters – Homomorphic Filtering.

Image segmentation and feature analysis: Detection of Discontinuities – Edge operators – Edge linking and Boundary Detection – Thresholding – Region based segmentation – Morphological Watersheds – Motion Segmentation, Feature Analysis and Extraction.

Multi resolution analysis and compressions: Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Image compression: Fundamentals – Models – Elements of Information Theory – Error free compression – Lossy Compression – Compression Standards.

Application of image processing: Image classification – Image recognition – Image understanding – Video motion analysis – Image fusion – Steganography – Digital compositing Mosaics – Colour Image Processing.

REFERENCES

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, 2nd Edition, Pearson Education, 2003.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, “Digital Image Processing”, Tata McGraw-Hill Education, 2011
3. Milan Sonka, Valclav Halavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, 2nd Edition, Thomson Learning, 2001.
4. Anil K. Jain, “Fundamentals of Digital Image Processing”. Pearson Education, 2003

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CIE 105 (E): SPECIAL ELECTRICAL MACHINES

3 hours per week

Stepping Motor: Constructional features – Principle of operation – Modes of excitation – Torque production in variable reluctance stepping motor - Dynamic characteristics – Drive systems and circuit for open loop control – Closed loop control of stepping motor.

Switched Reluctance Motors: Constructional features – principle of operation – Torque equation – Power controllers – Characteristics and control microprocessor based controller.

Synchronous Reluctance Motors: Constructional features: axial and radial air gap Motors – Operating principle – Reluctance torque – phasor diagram –motor characteristics.

Permanent Magnet Synchronous Motros: Principle of operation –EMF –Power input and torque expressions –Phasor diagram –power controller-Torque speed characteristics-Self control –Vector control –current control schemes.

Permanent Magnet Brushless Dc Motors: Commutation in DC motors, Difference between mechanical and electronic commutators- Hall sensors, Optical sensors - Multiphase Brushless motor –Square wave permanent magnet brushless motor drives –Torque and emf equation-Torque speed characteristics-Controllers –Microprocessors based controller

REFERENCES

1. Miller, T.J.E. “Brushless permanent magnet and reluctance motor drives”,Clarendon Press, Oxford,1989.
2. Kenjo, T, “Stepping motors and their microprocessor control ”,Clarendon Press,Oxford 1989.
3. R.Krishnan, “Switched Reluctance Motors Drives: Modelling, Simulation, Analysis Design and Applications”, CRC Press, New York, 2001.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 106 (A): PRINCIPLES OF ROBOTICS

3 hours per week

Introduction And Terminologies: Definition-Classification-History- Robots components-Degrees of freedom-Robot joints- coordinates- Reference frames-workspace-Robot languages-actuators-sensors- Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors-proximity and range sensors-social issues

Kinematics: Mechanism-matrix representation-homogenous transformation-DH representation-Inverse kinematics-solution and programming-degeneracy and dexterity

Differential Motion & Velocities: Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Design-Lagrangian mechanics-dynamic equations-static force analysis

Robot Control System: Sensor characteristics- Hydraulic, Pneumatic and electric actuators-trajectory planning- decentalised PID control- non-linear decoupling control

Image Processing & Vision Systems: Two and three dimensional images-spatial and frequency domain representation-noise and edges- convolution masks-Processing techniques-thersholding-noise reduction-edge detection-segmentation-Image analysis and object recognition

REFERENCES

1. Saeed B. Niku ,''Introduction to Robotics '', Pearson Education, 2002
2. Fu, Gonzalez and Lee Mcgrahill ,''Robotics '', international Special
3. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 106 (B): CHEMICAL PROCESS SYSTEMS

3 hours per week

Typical products and their and uses, Systematic analysis of chemical processes. Flow sheets and symbols for various operations. Variation in process conditions, raw materials and fuels – effect on end products and economy.

Overall Balances, Component balances in engineering equipment, combustion reactions, Stoichiometric balances in manufacturing processes.

Forms of energy, Total balance, Heat balance, Heat effects and combustion reactions,Energy balances in manufacturing processes, optimum utilization of energy, Heat transferoperations in chemical reactors. Equipments- Fundamental concepts in heat exchangers,Evaporators and distillation column, Design and classification of heat exchangers,Evaporators and distillation column.

Fundamental principles and classification of heat exchangers, Evaporators, Distillation columns and equipment for Agitation and mixing of fluids dimensional analysis to estimate power consumption for agitation.

Energy Conservation in process systems and industries, Optimization principles and pinch analysis to calculate energy consumption.

TEXT BOOK:

1. W.L. McCabe, J.C. Smith and P. Harriott, “Unit Operations of Chemical Engineering”, sixth Edition, McGraw Hill, 2001.
2. Walter L.Badger and Julivst. Banchero “Introduction to Chemical Engineering”, Tata McGraw Hill publishing company, 1997

REFERENCES:

1. L.B. Anderson and L.A. Wenzel, “Introduction to Chemical Engineering”, McGraw Hill, 1961.
2. P.Harriot, “Process Control”, McGraw Hill, 1984.
3. D.A. Reay, “Industrial Energy Conservation”, McGraw-Hill, New York, 1979.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 106 (C): CONTROL OF ELECTRIC DRIVES

3 hours per week

Converter Fed DC Drives: Microcontroller hardware circuit, flow charts waveforms, Performance characteristics of dc drives fed through single phase converters, 3-phase converters, dual converters, 1-phase fully controlled converter and 3-phase fully controlled converter fed dc drive.

Chopper Fed DC Drives: Microcontroller hardware circuits and waveforms of various modes of operation of chopper fed DC drives.

Inverter Fed Induction Motor Drive: Microcomputer controlled VSI fed induction motor drive - Detailed power circuit, generation of firing pulses and firing circuit, flow charts and waveforms for 1-phase, 3-phase Non-PWM and 3-phase PWM VSI fed induction motor drives. Sampling techniques for PWM inverter.

Mathematical Modeling of Frequency Controlled Drive: Development of mathematical model for various components of frequency controlled induction drive, mathematical model of the system for steady state and dynamic behaviour, Study of stability based on the dynamic model of the system.

Closed Loop Control of Microcomputer Based Drives: Voltage, Current, Torque and Speed measurements using digital measurement techniques. Types of controllers, position and velocity measurement algorithm, closed loop control of microcomputer based drives.

TEXT BOOKS:

1. Bose.B.K., Power Electronics and Motor Drives - Advances and Trends, IEEE Press, 2006.
2. Buxbaum, A. Schierau, and K.Staughen, “A design of control systems for DC drives”, Springer-Verlag, Berlin,1990.
3. Thyristor control of Electric drives, Vedam Subrahmanyam, Tata McGraw Hill, 1988.

REFERENCES:

1. R.Krishnan, “Electric Motor Drives, Modeling, Analysis and Control” Prentice Hall of India, 2002.
2. Bin Wu, “High Power Converters and AC Drives”, IEEE Press, A John Wiley and Sons, Inc., 2006.
3. Dubey G.K., Power semiconductor controlled drives, Prentice-HALL 1989
4. Control of Electric Drives, Leonard W, Springer Verlag, NY, 1985
5. Bose B.K., Microcomputer control of power electronics and drives, IEEE Press, 1987.
6. Bose B.K., Adjustable Speed A.C. drives, IEEE Press, 1993.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 106 (D): MICRO ELECTRO MECHANICAL SYSTEMS

3 hours per week

OVERVIEW OF MEMS History of MEMS, MEMS and Microsystems, Scaling laws in Miniaturization. Materials for MEMS and Microsystems.

MICRO FABRICATIONS AND MICROMACHINING: Microsystem Design and Fabrication, Microsystem fabrication processes- Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical and Physical Vapor deposition, Deposition by Epitaxy, Etching. Bulk Micro manufacturing, Surface micromachining, LIGA process.

PHYSICAL MICROSENSORS Design of Acoustic wave sensors, resonant sensor,Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors.

MICROACTUATORS Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps.

CASE STUDIES Ink jet pointer heads, Micro mirror TV Projector, DNA chip, Micro arrays, and RF electronic devices.

REFERENCES

1. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.
2. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001
3. B.H. Bao, “Analysis and design principles of MEMS Devices”, Elsevier, 2005.
4. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.
5. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 106 (E): ADVANCED DIGITAL SIGNAL PROCESSING

3 hours per week

Mathematical description of change of sampling rate – Interpolation and Decimation, Filter implementation for sampling rate conversion – direct form FIR structures, DTFT, FFT, Wavelet transform and filter bank implementation of wavelet expansion of signals

Discrete Random Processes – Ensemble averages, Stationary processes, Autocorrelation and Auto covariance matrices. Parseval"s Theorem, Wiener-Khintchine Relation – Power Spectral Density**.** AR, MA, ARMA model based spectral estimation. Parameter Estimation, Linear prediction – Forward and backward predictions, Least mean squared error criterion – Wiener filter for filtering and prediction, Discrete Kalman filter.

Basic Architecture – Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA.

Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control.

Introduction to TMS 320C6XProcessor – Architecture – Functional units - pipelining –Registers – Linear and Circular addressing modes –Types of instructions – sample programs

Basics on DSP sytem architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

REFERENCES:

1. Bernard Widrow, Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, third edition, 2004.
2. Dionitris G. Manolakis, Vinay K. Ingle, Stepen M. Kogon,"Statistical & Adaptive signal processing, spectral estimation, signal modeling, Adaptive filtering & Array processing", McGraw-Hill International edition 2000.
3. Monson H. Hayes, "Statistical Digital Signal Processing and Modelling", John Wiley and Sons, Inc.,
4. John G. Proaks, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education 2002.
5. S. Salivahanan, A. Vallavaraj and C. Gnanapriya "Digital Signal Processing", TMH,2000.
6. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India, 2004.
7. Lars Wanhammer, "DSP Integrated Circuits", Academic press, 1999,New York.
8. Ashok Ambardar,"Digital Signal Processing: A Modern Introduction",Thomson India edition, 2007.
9. Lars Wanhammer, "DSP Integrated Circuits", Academic press, 1999,New York.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 107(P): INDUSTRIAL INSTRUMENTATION LAB

2 hours per week

1. Measurement of temperature, level, and flow – study of characteristics of transducers and signal conditioning circuits.
2. Signal Conditioning Circuit for Temperature Measurement & Square root extractor in flow measurement – Implementation.
3. Measurement of torque, displacement, and distance – Implementation of signal conditioning circuits and study of characteristics of transducers.
4. Measuring the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric) – Implementation of a complete set-up to display the speed.
5. Use of light sensors - applications.
6. Data acquisition cards – Familiarisation of facilities – Analog i/p, analog o/p, digital i/p, digital o/p.
7. Development of virtual instrument (VI) for level measurement-with display, and visual and sound alarms
8. Development of virtual instrument (VI) for temperature measurement-with display, and visual and sound alarms
9. Developing a data logger
10. Modeling of inverted pendulum and to plot its response
11. Calibration of pressure gauges – dead weight pressure gauge
12. pH meter standardization and measurement of pH values of solutions
13. Measurements of conductivity of test solutions.
14. To test experimental data for Normal Distribution using Chi Square test.

The student is expected to complete at least 11 experiments.

CIE 108 (P) – SEMINAR

3 hours per week

The student shall prepare a Paper and present a Seminar on any current topic related to the branch of specialization under the guidance of a staff member. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester. The student shall submit typed copy of the paper to the Department. Grades will be awarded on the basis of contents of the paper and the presentation. A common format in (.pdf format) shall be given for reports of Seminar and Project. All reports of Seminar and Project submitted by students shall be in this given format.

Sessional work assessment

Presentation: 25
Report: 25
Total marks: 50

CIE 201: BIOMEDICAL INSTRUMENTATION

3 hours per week

Fundamentals of medical instrumentation – physiological systems of body –regulation of medical devices – origin of bio potentials – Sodium –Potassium pump –Goldman Hodgkin – Katz equation – biomedical transducers – electrode-electrolyte interface – half cell potential – ECG – 12 lead systems – cardiac pacemakers – defibrillators - EMG – EEG.

Preprocessing of biosignals - removal of interferences due to power line & Electro Surgical Unit, Adaptive filtering- fetal heart rate monitoring – ECG- continuous monitoring, arrhythmia detection- algorithms. and methods, HRV signal. EEG- video EEG, analysis of epilepsy using EEG.

Measurement of cardiac output – indicator dilution method – ultrasonic blood flow meter – electromagnetic blood flow meter – blood pressure measurement – oximetry – ear oximeter – pulse oximeter –skin reflectance oximeter -measurement on pulmonary system – spirometry – pulmonary function analyzers –respiratory parameters-ventilators

Lasers in medicine – Argon laser – Carbon dioxide laser -laser safety –X ray applications –X-ray machine – dental X-ray machine – ultra sound in medicine –electro therapy – hemodialysis – artificial kidney – dialyzers –membranes for hemodialysis

Measurement of $p_{H,}$ pCO_2 , pO_{2} - radiotherapy – Cobalt 60 machine – medical linear accelerator machine – audiometry - electrical safety in hospitals

References

1. J. G. Webster, Biomedical Instrumentation, John Wiley and Sons, Hoboken, NJ, 2004.
2. J. Carr and J. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2000.
3. R. S. Khandpur, Hand book of Biomedical Instrumentation, Prentice Hall of India Pvt Ltd, New Delhi, India, 1996.
4. W.J. Tomkins, Biomedical digital signal processing, PH publication, New Dehli 2004
5. Geddes & Baker , Principles of applied biomedical instrumentation Wiley Inter science , 3rd edition, 1975
6. Joseph D Bronzino, Biomedical engineering hand book, CRC Press, 2000
7. Metin Akay (editor), Wiley encyclopedia of biomedical engineering , Wiley, 2003

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CIE 202: SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

3 hours per week

Models for Indentification: Models of LTI systems: Linear Models-State space Models-OE model-Model sets, Structures and Identifiability-Models for Time-varying and Non-linear systems: Models with Nonlinearities – Non-linear state-space models-Black box models, Fuzzy models‟.

Non-Parametric and Parametric Identificaton: Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square – Forgetting factor- Maximum Likelihood – Instrumental Variable methods.

Non-Linear Identification and Model Validation: Open and closed loop identification: Approaches – Direct and indirect identification – Joint input-output identification – Non-linear system identification – Wiener models – Power series expansions - State estimation techniques – Non linear identification using Neural Network and Fuzzy Logic.

Adaptive Cotrol and Adaptation Techniques: Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC – Different approaches to self-tuning regulators – Stochastic Adaptive control – Gain Scheduling.

Case Studies**:** Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

REFERENCES

1. L. Ljung," System Identification Theory for the User", PHI, 1987.
2. Torsten Soderstrom, Petre Stoica, "System Identification", prentice Hall ` International (UK) Ltd,1989.
3. Astrom and Wittenmark," Adaptive Control ", PHI
4. William S. Levine, " Control Hand Book".
5. Narendra and Annasamy," Stable Adaptive Control Systems, Prentice Hall, 1989

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 203: SCADA SYSTEMS & APPLICATIONS

3 hours per week

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

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 fiber optics. open standard communication protocols

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,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003

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CIE 204 (A): DESIGN OF EMBEDDED SYSTEMS

3 hours per week

EMBEDDED DESIGN LIFE CYCLE Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability – Tool chain availability – Other issues in selection processes.

PARTITIONING DECISION Hardware / Software duality – coding Hardware – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization – System startup – Hardware manipulation – memory mapped access – speed and code density.

INTERRUPT SERVICE ROUTINES Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimisation – Statistical profiling

IN CIRCUIT EMULATORS Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

TESTING Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

REFERENCE

1. Arnold S. Berger – “Embedded System Design”, CMP books, USA 2002.

2. Sriram Iyer, “Embedded Real time System Programming”

3. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 204 (B): REAL TIME OPERATING SYSTEMS

3 hours per week

REVIEW OF OPERATING SYSTEMS Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Distributed scheduling.

OVERVIEW OF RTOS RTOS Task and Task state - Process Synchronisation- Message queues – Mail boxes - pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

REAL TIME MODELS AND LANGUAGES Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

REAL TIME KERNEL Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and study of various RTOS like QNX – VX works – PSOS – C Executive – Case studies.

RTOS APPLICATION DOMAINS RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.

REFERENCES:

1. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
2. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
3 Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill 1997.
4 C.M. Krishna, Kang, G.Shin, “Real Time Systems”, McGraw Hill, 1997.
5. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, PHI 1999.
6. Mukesh Sighal and N G Shi “Advanced Concepts in Operating System”, McGraw Hill 2000.

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CIE 204 (C): PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES

3 hours per week

Probability and random variables: Meaning of probability, axioms of probability, repeated trials, concept of random variable, Distributions and density functions, Conditional probability and total probability

Functions of one random variable: random variable g(x), distribution of g(x), mean, variance, moments, characteristic functions, two random variables, bivariate distribution, one function of two RVs, two functions of two RVs.

Moments and conditional statistics, joint moments, joint characteristic functions, conditional distributions, conditional expected values

Sequences of RVs: Conditional penalties, characteristic functions and normality, Mean square estimation, stochastic convergence and limittheorems, random numbers: meaning and generation

Introduction to stochastic processes: Definition and classification, Markov chains, Stationary distribution and ergodicity, Wiener process, Gaussian process, Elements of time series.

REFERENCES

1. Papoulis A., Probability, Random variables and stochastic processes, McGraw Hill, 1991.
2. Starks and Woods, Probability and Estimation Theory, Prentice-Hall
3. M. R. Spiegel, Probability and Statistics, Schaum'sOutline Series, McGraw -Hill Book Company, 1982.

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CIE 204 (D): FIBRE OPTIC COMMUNICATION

3 hours per week

Introduction to fiber optics; light propagation;optical fibers: modes, dispersion , nonlinear effects-implementation

Optical transmitters: LEDs, semiconductor lasers, transmitter design.

Optical Receivers: Photo detectors, receiver design , noise , sensitivity

System design & Performance: Voice , video , data transmission, analog and digital systems, standards.

Broadband Local Area Optical networks and WDM systems; coherent communication systems, long distance telecommunicationsusing optical amplifiers and solitons.

Fiber optic networks: components for optical networks; broadcast and select networks; wavelength routing networks; virtual topology design; control and management; Access networks, deployment considerations

Integrated Optics,MOEMS; microwave photonics,photonics switching,recent developments and futuristic issues.

REFERENCES:

1. A. Selvarajan, S. Kar and T. Srinivas, Optical Fiber Communications, Principles and Systems, Tata-Mc Graw Hill,2002
2. G.Keiser, Optical Fiber Communications, 2/e, McGraw Hill,1991
3. I. P. Kaminov and T. L. Koch, Optical Fiber Telecommunications IIIA and IIIB, Academic Press, 1997
4. R. Ramaswaminand K.N.Sivarajan, Optical Networks: A Practical Perspective, 2/e, Morgan Kuffmann Publishers, 2002
5. S.V. Kattalopoulos, Introduction to DWDM Technology, IEEE Press,2000
6. Current literature: Special issues of journals and review articles

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CIE 204 (E): ADVANCED PROCESS CONTROL

3 hours per week

Control relevant process modeling and identification: Model applications, types of models, empirical dynamic models, model structure considerations, model identification.

Identification examples: SISO furnace parametric model identification, MISO parametric model identification, MISO non-parametric identification of a non-integrating process, MIMO identification of an integrating and non-integrating process, design of plant experiments, conversion of model structures.

Linear multivariable control: Interaction in multivariable systems, Dynamic matrix control, properties of commercial MPC packages.

Multivariable optimal constraint control algorithm: Model formulation for systems with dead time, model formulation for multivariable processes with and without time delays, model formulation in case of a limited control horizon, Non-linear transformations.

Nonlinear multivariable control: Non-linear model predictive control, non-linear quadratic DMC, generic model control, GMC application to chemical engineering systems, one step reference trajectory control.

TEXT BOOKS/REFERENCES:

1. B. Roffel, B.H.L. Betlem, "Advanced Practical Process Control" Springer, 2004.
2. Jean Pierre Corriou, "Process Control: Theory and applications" Springer, 2004.
3. C.A. Smith and A.B. Corrupio," Principles and Practice of Automotive Process Control", John Wiley, New York, 1976

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CIE 205 (A): ADVANCED TOPICS IN NON LINEAR CONTROL

3 hours per week

PERTURBATION THEORY: Vanishing and Non vanishing Perturbations – Continuity of solutions on the infinite interval – Interconnected systems – Slowly varying systems – Perturbation method – Averaging - Weakly nonlinear second-order oscillators – Exercises

SINGULAR PERTURBATIONS: Standard singular perturbation model – Time scale properties – Singular perturbation on the infinite interval – Slow and fast manifolds – stability analysis – exercises

GAIN SCHEDULING AND FEEDBACK LINEARIZATION: Control problem – stabilization via linearization – integral control via linearization – gain scheduling – Input output linearization – Full state linearization – state feedback control – tracking- exercises

INPUT-OUTPUT STABILITY: L stability – L stability of state models – L2 gain – feedback system: small gain theorem – exercises – Passivity – State models - L2 and Lyapunov stability

BAKSTEPPING CONTROL ALGORITHMS: Passivity based control – High gain observers – stabilization – Regulation via integral control - exercises

REFERENCES

1. Hasan Khalil," Nonlinear systems and control", 3rd ed, PHI,

2. Slotine, J A E Slotine and W Li, "Applied Nonlinear control",1991, PHI

3. S.H. Zak," Systems and control", Oxford University Press

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CIE 205 (B): SPEECH SIGNAL PROCESSING

3 hours per week

Speech Production: Acoustic theory of speech production (Excitation, Vocal tract model for speech analysis, Formant structure, Pitch). Articulatory Phonetic (Articulation, Voicing, Articulatory model). Acoustic Phonetics (Basicspeech units and their classification).

Speech Analysis: Short-Time Speech Analysis, Time domain analysis (Short time energy, short time zero crossing Rate, ACF).Frequency domain analysis (Filter Banks, STFT, Spectrogram, Formant Estimation &Analysis). Cepstral Analysis

Parametric representation of speech:- AR Model, ARMA model. LPC Analysis (LPC model, Auto correlation method, Covariance method, Levinson-Durbin Algorithm, Lattice form).LSF, LAR, MFCC, Sinusoidal Model, GMM, HMM

Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders, CELP

Speech processing: Fundamentals of Speech recognition, Speech segmentation. Text-tospeech conversion, speech enhancement, Speaker Verification, Language Identification, Issues of Voice transmission over Internet.

REFERENCES:

1. Douglas O'Shaughnessy, Speech Communications : Human & Machine, IEEE Press, Hardcover 2/e, 1999
2. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing : Processing and Perception Speech and Music,July 1999, John Wiley & Sons
3. Rabiner and Schafer, Digital Speech Processing ,Prentice Hall, 1978.
4. Rabiner L. R. and Juang B. H., Fundamentals of Speech Recognition,Prentice Hall, 1993.
5. Parsons T. W., Voice & Speech Processing Mc-GrawHill, 1989
6. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice,Prentice Hall
7. Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley & Sons, September 1999

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CIE 205 (C): BIOPROCESS INSTRUMENTATION & CONTROL

3 hours per week

Physical and chemical sensors; Biosensors; On-line sensors for cell properties; off-line Analytical methods.

Agitation and capacity coefficient in fermenters; Control of pH, dissolved oxygen, dissolved carbon dioxide, temperature of fermenters; Rheological measurement and control application of microcomputers in the study of microbial process.

Elements of Digital computers; Computer Interfaces and peripheral devices; Fermentation software systems. Data smoothing and interpolation; State and parameter estimation; Direct regulatory control; cascade control of metabolism.

Programmed batch bio-reaction; Design and operation strategies for batch plants; Continuous process control.

TEXT BOOKS:

1. *Bailey J.E. and Ollis,D.F. " Biochemical Engineering Fundamentals" 2nd Edition, (1986), McGraw Hill Book CO.,Singapore.*
2. *T.K.Ghose (Ed.) "Process Computations in Biotechnology" (1994), Tata McGraw Hill Publ.Co.,N.Delhi.*
3. A.Fischer (Ed.), "Advances in Biochemical Engineering," Vol. 13, 1973, Springer Verlag, Germany

REFERENCES:

1. *Aiba, Humphry and Millis, " Bio Chemical Engineering ", 2nd Ed., (1973), Academic press*
2. *McNeil and Harvey, "Fermentation - A Practical Approach" (1990). IRL Press, U.K.*
3. *Scragg, "Bioreactors in Biotechnology - A Practical Approach" (1991), Ellis Horwood Ltd., U.K.*

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CIE 205 (D): DIGITAL CONTROL SYSTEM DESIGN

3 hours per week

Discrete time signals, Discrete time systems, Sampling and reconstruction, digitizing analog controllers.

Discrete time state equations, discrete time system response, the characteristic value problem, Uncoupling state equations, Observability and controllability.

Observability and state observation, Estimation and identification, Controllability and state control, State feedback, Output feedback.

Full order state observer, Observer design, Lower-order observers, Eigenvalue placement with observer feedback.

Ideal tracking system design, Response model tracking system design, Reference model tracking system design.

REFERENCES:

1. Gene H. Hostetter, Digital Control System, Second Edition Holt,Rinehart and Winston, Inc.U.S, 1997.
2. Ogata K, Discrete Time Control Systems, Pearson Education, 2001.
3. Gopal M, Digital Control and State variable Methods, Second Edition, Tata McGrawHill, New Delhi, 2003.

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CIE 205 (E): OPTIMAL CONTROL THEORY

3 hours per week

Problem formulation – Mathematical model – Physical constraints – Performance measure Optimal control problem. Form of optimal control. Performance measures for optimal control problem. Selection a performance measure.

Dynamic Programming – Optimal control law – Principle of optimality. An optimal control system. A recurrence relation of dynamic programming – computational procedure. Characteristics of dynamic programming solution. Hamilton – Jacobi – Bellman equation. Continuous linear regulator problems.

Calculus of variations – Fundamental concepts. Functionals. Piecewise – smooth extremals Constrained extrema.

Variational approach to optimal control problems – Necessary conditions for optimal control – Linear regulator problems. Linear tracking problems. Pontryagin's minimum principle and state inequality constraints.

Minimum time problems – Minimum control – effort problems. Singular intervals in optimal control problems. Numerical determination of optimal trajectories – Two point boundary – valve problems. Methods of steepest decent, variation of extremals. Quasilinearization. Gradient projection algorithm.

TEXTBOOK:

1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, 1970.

REFERENCES:

1. Anderson .B. D. O, Moore .J. B, Optimal control linear Quadratic methods, Prentice Hall of India, New Delhi, 1991.
2. Sage A. P, White .C. C, Optimum Systems Control, Second Edition, Prentice Hall, 1977.

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CIE 206 (A): ENERGY AUDITTING AND MANAGEMENT

3 hours per week

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-specific energy analysis-Minimum energy paths-consumption models-Case study.

Electric motors-Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis-Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.

Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing - Optimal operation and Storage; Case study

Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study.

Reactive Power management-Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance, case study.

Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study.

Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study.

Cogeneration-Types and Schemes-Optimal operation of cogeneration plants-case study;

Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Gysers-Solar Water Heaters- Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls- software-EMS

References

1. Handbook on Energy Audit and Environment Management , Y P Abbi and Shashank Jain, TERI, 2006

2. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 20093. Giovanni Petrecca, .Industrial Energy Management: Principles and Applications., The Kluwer international series -207,1999

4. Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management., Pennwell Pub; (1998)

5. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2nd edition (1994)

6. Turner, Wayne C., .Energy Management Handbook., Lilburn, The Fairmont Press, 2001

7. Albert Thumann , .Handbook of Energy Audits., Fairmont Pr; 5th edition (1998)

8. IEEE Bronze Book- .Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities., IEEE Inc, USA. 2008

9. Albert Thumann, P.W, -.Plant Engineers and Managers Guide to Energy Conservation. - Seventh Edition-TWI Press Inc, Terre Haute, 2007

10. Donald R. W., .Energy Efficiency Manual., Energy Institute Press, 1986

11. Partab H., 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Sons, New Delhi. 1975

12. Tripathy S.C.,'Electric Energy Utilization And Conservation', Tata McGraw Hill, 1991

13. NESCAP-Guide Book on Promotion of Sustainable Energy Consumption, 2004

14. IEEE Bronze Book, IEEE STD 739

15. IEEE Recommended Practices for Energy Management in Industrial and Commercial Facilities

16. Guide to Energy Management, Sixth Edition , Barney L. Capehart (Author William J. Kennedy, Fairmont Press; 6 edition (April 23, 2008)

17. Energy Efficiency Manual: for everyone who uses energy, pays for utilities, designs and builds, is interested in energy conservation and the environment, Donald R. Wulfinghoff, Energy Institute Press (March 2000)

18. Handbook of Energy Audits, Seventh Edition, Albert Thumann., William J. Younger, Fairmont Press; 7 edition (November 12, 2007)

19. Certified Energy Manager Exam Secrets Study Guide: CEM Test Review for the Certified Energy Manager Exam CEM Exam Secrets Test Prep Team Mometrix Media LLC (2009)

20.Handbook of Energy Engineering, Sixth Edition Albert Thumann , D. Paul Mehta Fairmont Press; 6 edition (June 24, 2008)

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CIE 206 (B): MICRO CONTROLLER BASED SYSTEM DESIGN

3 hours per week

8051 ARCHITECTURE : Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication.

8051 PROGRAMMING : Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming Interrupt Programming – RTOS for 8051 – RTOSLite – FullRTOS –Task creation and run – LCD digital clock/thermometer using FullRTOS. T ypical microcontroller applications- DC motor speed control - Temperature control - Stepper motor control - PIDcontrol

PIC MICROCONTROLLER : Architecture – memory organization – addressing modes – instruction set – PIC progrmming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MP-LAB.

PERIPHERAL OF PIC MICROCONTROLLER : Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

SYSTEM DESIGN – CASE STUDY :
Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling AC appliances –Measurement of frequency - Stand alone Data Acquisition System.

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey „ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18‟, Pearson Education 2008
2. John Iovine, „PIC Microcontroller Project Book ‟, McGraw Hill 2000
3. Myke Predko, “Programming and customizing the 8051 microcontroller”, Tata McGraw Hill 2001.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 206(C) RESEARCH METHODOLOGY

3 hours per week

Introduction – Meaning of research – Objectives of research – Motivation in research –Types of research – Research approaches – Significance of research – Research methods vs Methodology – Criteria of good research.

Defining Research Problem – What is a research problem – Selecting the problem –Necessity of defining the problem – Literature review – Importance of literature review in defining problem – Critical literature review – Identifying gap areas from literature review

Research design – Meaning of research design – Need– Features of good design –Important concepts relating to research design – Different types – Developing a research plan

Method of data collection – Collection of data- observation method – Interview method – Questionnaire method – Processing and analysis of data – Processing options – Types of analysis – Interpretation of results

Report writing – Types of report – Research Report, Research proposal ,Technical paper – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Simple exercises – Oral presentation – Planning – Preparation –Practice – Making presentation – Answering questions - Use of visual aids – Quality & Proper usage – Importance of effective communication – Illustration

REFERENCES:

1. Coley S M and Scheinberg C A, 1990, "Proposal Writing",Newbury Sage Publications.
2. Leedy P D, "Practical Research : Planning and Design",4th Edition, N W MacMillan Publishing Co.
3. Day R A, "How to Write and Publish a Scientific Paper",Cambridge University Press,1989.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 206 (D): PIPING AND INSTRUMENTATION

3 hours per week

Types of flow sheets, Flow sheet Presentation, Flow Sheet Symbols, Process flow diagram- Synthesis of steady state flow sheet - Flow sheeting software.

P & I D objectives, guide rules, Symbols, Line numbering, Line schedule, P & I D development, typical stages of P & I D.

P & I D for rotating equipment and static pressure vessels, Process vessels, absorber, evaporator.

Control System for Heater, Heat exchangers, reactors, dryers, Distillation column, Expander.

Applications of P & I D in design stage - Construction stage - Commissioning stage - Operating stage - Revamping stage - Applications of P & I D in HAZOPS and Risk analysis.

TEXT BOOKS:

1. Ernest E. Ludwig, "Applied Process Design for Chemical and Petrochemical Plants", Vol.-I Gulf Publishing Company, Houston, 1989.
2. Max. S. Peters and K.D.Timmerhaus, "Plant Design and Economics for Chemical Engineers", McGraw Hill, Inc., New York, 1991.

REFERENCES:

1. Anil Kumar,"Chemical Process Synthesis and Engineering Design", Tata McGraw Hill publishing Company Limited, New Delhi - 1981.
2. A.N. Westerberg, et al., "Process Flowsheeting", Cambridge University Press, 1979.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 205 (E): PROGRAMMING WITH VHDL

3 hours per week

VHDL FUNDAMENTALS : Fundamental concepts- Modeling digital system-Domain and levels of modeling-modeling languages-VHDL modeling concepts-Scalar Data types and operations-constants and Variable-Scalar Types- Type Classification-Attributes and scalar types-expression and operators-Sequential statements.

DATA TYPES AND BASIC MODELING CONSTRUCTS : Arrays- unconstrained array types-array operations and referencing- records - Access Types- Abstract Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions-design Processing, case study: A pipelined Multiplier accumulator.

SUBPROGRAMS , PACKAGES AND FILES: Procedures-Procedure parameters- Concurrent procedure call statements –Functions –Overloading –visibility of Declarations-packages and use clauses-Package declarations-package bodies-use clauses-Predefined aliases-Aliases for Data objects-Aliases for Non-Data items-Files- I/O-Files. Case study: A bit vector arithmetic Package.

SIGNALS, COMPONENTS, CONFIGURATIONS: Basic Resolved Signals-IEEE std_Logic_1164 resolved subtypes- resolved Signal Parameters - Generic Constants- Parameterizing behavior- Parameterizing structure-components and configurations-Generate Statements-Generating Iterative structure-Conditionally generating structure-Configuration of generate statements-case study: DLX computer Systems.

DESIGN WITH PROGRAMMABLE LOGIC DEVICES: Realization of -Micro controller CPU.- Memories-I/O devices-MAC-Design,synthesis,simulation and testing.

REFERENCES

1. Peter J.Ashenden, “The Designer‟s guide to VHDL”, Morgan Kaufmann publishers,San Francisco,Second Edition, May 2001.
2. Zainalabedin navabi, “VHDL Analysis ans modeling of Digital Systems”, McGraw Hill international Editions, Second Editions, 1998.
3. Charles H Roth, Jr. “Digital system Design using VHDL”, Thomson ,2006.
4. Douglas Perry, “VHDL Programming by Example”, Tata McGraw Hill,4th Edition 2002.
5. Navabi.Z., “VHDL Analysis and Modeling of Digital Systems”, McGraw International, 1998.
6. Peter J Ashendem, “The Designers Guide to VHDL”, Harcourt India Pvt Ltd, 2002
7. Skahill. K, “VHDL for Programmable Logic”, Pearson education, 1996.

Question Pattern: There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CIE 207(P): PROCESS CONTROL LAB

2 hours per week

1. ON-OFF controller with and without neutral zone-level control, flow control
2. Temperature, flow, and level control using P, PI, PD, and PID controllers–Comparison and study of output responses of each process.
3. Controller Tuning using Ziegler-Nichols and Cohen and Coon rules-for temperature and level processes
4. PLC-ladder diagram implementation and control of industrial control systems.
5. Using MODBUS or other communication protocol for Process Control
6. Experimentation of Control loops for Inverted Pendulum
7. Simulation of feed-forward, cascade, and ratio controls using suitable software.
8. Experimental Study of DCS and SCADA in a process control system.
9. Study of performance and automation of a flexible manufacturing trainer
10. PC based control of robotic actions or similar systems
11. Computation of time response - analysis of stability, controllability, and observability – using suitable computing software
12. Pole placement using state feed back
13. Study of control valve characteristics
14. Design and simulation of regulator systems
15. Design of observers
16. Design of controllers

The student is expected to complete at least 13 experiments.

As part of this laboratory, the student shall visit a process industry in order to study the working of a typical control system. A report shall be submitted with detailed sketches, description, analysis of the control system.

CIE 208 (P): TERM PAPER

The student is expected to present a report on the literature survey conducted as a prior requirement for the project to be taken up in the third and fourth semesters. Head of department can combine TP hours of many weeks and allot a maximum of 4 weeks exclusively for it. Students should execute the project work using the facilities of the institute. However, external projects can be taken up, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work. Project evaluation committee should study the feasibility of each project work before giving consent. An overview on the project work should be introduced before the closure of first semester. A paper should be prepared based on the project results and is to published in refereed Conferences/Journals. Grades will be awarded on the basis of contents of the paper and the presentation.

Sessional work assessment

Presentation: 25
Report: 25
Total marks: 50

CIE 301 (P): THESIS PRELIMINARY

22 hours per week

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis-Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, 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.

Weightages for the 8 credits allotted for the Thesis-Preliminary

Evaluation of the Thesis-Preliminary work: by the guide - 50% (200 Marks)
Evaluation of the Thesis–Preliminary work: by the Evaluation Committee-50% (200 Marks)

CIE 401 (P): THESIS

22 hours per week

Towards the end of the semester there shall be a pre-submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consist of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. At least one technical paper is to be prepared for possible publication in journal/conference. The final evaluation of the thesis shall be an external evaluation. The 12 credits allotted for the Thesis-Final may be proportionally distributed between external and internal evaluation as follows.

Weightages for the 12 credits allotted for the Thesis

Internal Evaluation of the Thesis work: by the guide - (200 Marks)
Internal Evaluation of the Thesis work: by the Evaluation Committee - (200 Marks)

Final Evaluation of the Thesis work by the Internal and External Examiners:-
(Evaluation of Thesis + Viva Voce) - (100+100 Marks)