UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M.E. INSTRUMENTATION ENGINEERING

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA9117	Applied Mathematics for Instrumentation Engineers	3	1	0	4
2.	IN9111	Transducers and Smart Instruments	3	0	0	3
3.	IN9112	Process Control	3	0	0	3
4.	IN9113	Real Time Embedded System	3	0	0	3
5.	IN9114	Industrial Data Networks	3	0	0	3
6.	E1	Elective – I	3	0	0	3
PRACTICAL						
7.	IN9115	Process Control & Instrumentation Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**3**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	IN 9121	Advanced Process Control	3	0	0	3
2.	IN 9122	Applied Soft Computing	3	0	0	3
3.	IN 9123	Instrumentation System Design	3	0	0	3
4.	IN 9124	Applied Industrial Instrumentation	3	0	0	3
5.	E2	Elective – II	3	0	0	3
6.	E3	Elective - III	3	0	0	3
PRACTICAL						
7.	IN 9125	Industrial Automation Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**3**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	E4	Elective IV	3	0	0	3
2.	E5	Elective V	3	0	0	3
3.	E6	Elective VI	3	0	0	3
PRACTICAL						

4.	IN 9131	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	IN 9141	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD THE DEGREE = 68

ELECTIVES FOR M.E INSTRUMENTATION ENGINEERING

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	IN9151	Thermal Power Plant Instrumentation	3	0	0	3
2.	IN9152	System Theory	3	0	0	3
3.	IN9153	Applied Biomedical Instrumentation	3	0	0	3
4.	IN9154	Cryptography and Network Security	3	0	0	3

SEMESTER II

SL. NO	COURS CODE	COURSE TITLE	L	T	P	C
5.	IN9155	VLSI System Design	3	0	0	3
6.	IN9156	Optimal Control	3	0	0	3
7.	IN9157	Robust Control	3	0	0	3
8.	IN9158	Robotics and Automation	3	0	0	3
9.	IN9159	System Identification	3	0	0	3
10.	IN9160	Advanced Operating System	3	0	0	3

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
11	IN9161	Instrumentation in Petrochemical Industry	3	0	0	3
12.	IN9162	Industrial Drives and Control	3	0	0	3
13.	IN9163	State Estimation	3	0	0	3
14.	IN9164	Advanced DSP	3	0	0	3
15.	IN9165	Wireless Sensor Network	3	0	0	3
16.	IN9166	Biosignal Processing	3	0	0	3
17.	IN9167	Fault Detection and Diagnosis	3	0	0	3

18.	IN9168	Virtual Instrumentation	3	0	0	3
19.	IN9169	Adaptive Control	3	0	0	3

MA 9117 APPLIED MATHEMATICS FOR INSTRUMENTATION ENGINEERS L T P C
3 1 0 4

1.LINEAR ALGEBRA 9

Vector spaces – norms – Inner Products – Eigen values using QR transformations – generalized eigenvectors – Canonical forms – singular value decomposition and applications.

2. DIFFERENTIAL EQUATIONS-NONLINEAR, ODE & PDE 9

Introduction- Equations, with separable variables- Equations reducible to linear form- Bernoulli's Equation- Riccati's equation – Special forms of Riccati's equation- Laplace transform methods for one dimensional wave equation- Displacements in a long string- longitudinal vibration of an elastic bar.

3. CALCULUS OF VARIATION 9

Introduction- Euler's equation- Several dependent variables Lagrange's equations of Dynamics- Integrals involving derivatives higher than the first- Problems with constraints- Direct methods and eigen value problems.

4. LINEAR PROGRAMMING PROBLEM 9

Introduction- Simplex algorithm- Two phase and Big M Techniques – Duality theory- Integer programming- Branch and Bound Method.

5. DYNAMIC PROGRAMMING 9

Elements of the dynamic programming model- Optimality principle- Examples of dynamic programming models and their solutions.

L +T: 45+15 = 60

REFERENCES:

1. Bronson, R., Matrix Operations, Schaum's outline series, McGraw Hill, New York., 1989.
2. Stephenson, G.Radmore, P.M., Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press1999.
3. Guptha., A.S.Calculus of variations with applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
4. Taha, H.A. Operations, Research, An Introduction, Seventh edition, Pearson Education Edition, New Delhi, 2003.
5. Sankara Rao, K., Introduction to parial differential Equations, Prentice Hall of India, New Delhi, 1997.

IN 9111 TRANSDUCERS AND SMART INSTRUMENTS **L T P C**
3 0 0 3

1.REVIEW OF MEASUREMENT SCIENCE AND CONVENTIONAL TRANSDUCERS 9

Types of errors – Limiting error – probable error – propagation of error – odds and uncertainty – static and dynamic characteristics – strain gauges – LVDT – capacitive transducers – piezo electric transducers.

2.SENSORS FOR SPATIAL VARIABLES, OPTICAL VARIABLES, CHEMICAL VARIABLES & ENVIRONMENTAL MEASUREMENT 9

Spatial variable measurement: Laser Interferometer Displacement sensor-synchro /Resolver displacement transducer. Optical variables measurement: Vision and image sensors. Chemical variables measurement: Thermal composition measurement – Kinetic methods.Environmental measurement: Meteorological measurement – Air pollution measurement – Water quality measurement – Satellite imaging and sensing.

3.SMART SENSORS 9

Primary and Secondary sensors – Amplification – Filters – Converters – Compensation – Information coding / processing – Data communication, standards for smart sensor interface – Smart transmitter with HART communicator – Smart sensor for flow and temperature measurement

4.MICRO SENSORS AND ACTUATORS 9

Micro system design and fabrication – Micro pressure sensors (piezo resistive and capacitive) – Resonant sensors – Acoustic wave sensors – Bio micro sensors – Micro actuators – Micro mechanical motors and pumps.

5.RECENT TRENDS IN SENSOR TECHNOLOGIES 9

Film sensors : Thick film and thin film – Integrated image sensors – Bio sensors – Integrated micro arrays – RF - IDs – Sensor arrays – Sensor network – Multisensor data fusion – Soft sensor.

TOTAL : 45 PERIODS

REFERENCES

1. John G Webster , Measurement , Instrumentation and Sensors Handbook , CRC press IEEE press, 1998
2. Bela G Liptak , Instruments Engineers' Handbook Process Measurement and Analysis , Elsevier , 2005
3. Patranabis D, Sensors and Transducers, PHI, 2006.
4. Tai Ran Hsu , Mems and micro systems design & manufacture , Tata McGraw

Hill , 2002

IN 9112 **PROCESS CONTROL** **L T P C**
3 0 0 3

1. PROCESS DYNAMICS **9**

Need for process control – Review of Laplace transform and z-transform – Modified of z-transform – Pulse transfer function - Continuous and batch processes – Self regulation – Servo and regulatory operations - Interacting and non-interacting systems – Degrees of freedom - Linearization of nonlinear systems- Mathematical model of Level and Thermal processes – Lumped and Distributed parameter models - Identification of Transfer function model parameters using non-parametric approaches- state space model representation.

2. CONTROL ACTIONS & FINAL CONTROL ELEMENTS **9**

Characteristic of ON-OFF, P, P+I, P+D and P+I+D control modes – Electronic PID controller –Digital PID algorithm – Auto/manual transfer - Reset windup – Practical forms of PID Controller - Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves:- Inherent and Installed characteristics – Modeling of pneumatic control valve

3. CONTROLLER TUNING –SINGLE LOOP REGULATORY CONTROL **9**

Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio - Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation method – Determination of optimum settings for mathematically described processes using time response and frequency response approaches –pole placement –lamda tuning- algebraic design – optimization methods – robust loop shaping

4. ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL **9**

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range – override control–- selective control –Auto tuning.

5. MODEL BASED CONTROL SCHEMES **9**

Dead-time compensation: - Smith predictor control scheme- Internal Model Controller-IMC PID controller -Single variable Model predictive control – Single Loop DMC - Introduction to Plant-wide Control and Batch Control - P&ID diagram.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCE BOOKS

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.
2.Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Edition, 2004.

IN 9113 REAL TIME EMBEDDED SYSTEM **L T P C**
3 0 0 3

1. INTRODUCTION TO REAL TIME SYSTEMS **9**

Fundamentals of systems and real time system - Definitions, classification, features, issues and challenges - Introduction to real time operating systems – timeliness, scheduling and resource management - Implementation examples with commercial VxWorks and µC/Os.

2. REAL TIME SYSTEM DESIGN AND ANALYSIS **9**

Real time specification and design techniques-models-real time kernels- Characteristics and attributes of Real Time Kernel-kernel service-kernel implementation, performance analysis and optimization – Testing and Validation

3. EMBEDDED SYSTEM COMPONENTS AND ITS INTERFACE **9**

Embedded system definition- architecture and standards with examples- Embedded hardware-processors-memory devices-Interface and Peripherals-Power and its Management.

4. EMBEDDED SYSTEM DESIGN AND DEVELOPMENT **9**

Design methods and techniques – models and languages - state machine and state tables in embedded design – High level language descriptions in embedded system, Java based embedded system design – Simulation and Emulation of embedded systems- ARM processor based embedded boards- Examples with Microcontroller based embedded system development

5. CASE STUDIES **9**

Case studies of sector specific, time - critical and safety - critical real time embedded systems- Typical applications in automotives, communication, medicine and manufacturing- engine controls and antilock braking systems, Embedded mobile communication and positioning devices, pacemaker and patient monitoring systems, Robotics and control systems.

TOTAL : 45 PERIODS

REFERENCES

1. Phillip A. Laplante, ‘Real-Time Systems Design and Analysis: An Engineer's Handbook’, Wiley Publications,2004
2. Raymond J.A.Buhr Donaid L. Balley: An introduction to real time Embedded Systems, Prentice Hall International, 1999.
3. C.M. Krishna, Kang G.Shin, Real Time Systems, McGraw Hill, 1997.
4. Herma K,Real Time systems – Design for distributed embedded applications, Kluwer academic,1997.
5. Tamy Noergaard, Embedded Systems Architecture, ElseiverInc, 2005
6. D.E.Simon, An Embedded Software primer, Addison Wesley, 1999.
7. Gajski D.D. Vahid, F.,Narayan S.,Specification and design of embedded systems, PTR prentice hall, 1994
8. Arnold S.Berge, Embedded system design-An introduction to processors, tools and techniques, CMD.

IN 9114 INDUSTRIAL DATA NETWORKS L T P C
3 0 0 3

DATA NETWORK FUNDAMENTALS 9

EIA 232 interface standard – EIA 485 interface standard – EIA 422 interface standard – Serial interface converters - ISO/OSI Reference model – Data link control protocol – Media access protocol:-Command/response, Token passing and CSMA/CD - TCP/IP – Bridges – Routers – Gateways –Standard ETHERNET Configuration.

PLC, PLC PROGRAMMING & SCADA 9

Evolutions of PLCs – Programmable Controllers – Architecture – Comparative study of Industrial PLCs. –PLC Programming:- Ladder logic, Functional block programming, Sequential function chart, Instruction list and Structured text programming. SCADA:- Remote terminal units, Master station, Communication architectures and Open SCADA protocols.

DISTRIBUTED CONTROL SYSTEM & HART 9

Evolution - Different architectures - Local control unit - Operator Interface – Displays - Engineering interface - Study of any one DCS available in market - Factors to be considered in selecting DCS – Case studies in DCS. Introduction- Evolution of signal standard – HART communication protocol – Communication modes – HART Networks – HART commands – HART applications – MODBUS protocol structure – Function codes – Troubleshooting

PROFIBUS AND FF 9

Fieldbus:- Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability Profibus:- Introduction, Profibus protocol stack, Profibus communication model, Communication objects, System operation and Troubleshooting – Foundation fieldbus versus Profibus.

AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET 9

AS interface:- Introduction, Physical layer, Data link layer and Operating characteristics. Devicenet:- Introduction, Physical layer, Data link layer and Application layer. Industrial Ethernet:- Introduction, 10Mbps Ethernet and 100Mbps Ethernet - Introduction to OLE for process control (OPC).

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Hughes, T., “Programmable Logic Controllers”, ISA Press, 2000.
2. Bowden, R., “HART Application Guide”, HART Communication Foundation, 1999.
3. Mc-Millan, G.K., “Process/Industrial Instrument and Controls Handbook”, McGraw-Hill, NewYork, 1999.
4. Berge, J., “Field Buses for Process Control: Engineering, Operation, and Maintenance”, ISA Press, 2004.
5. Mackay, S., Wrijut, E., Reynders, D. and Park, J., “Practical Industrial Data Networks Design, Installation and Troubleshooting”, Newnes Publication, Elsevier, 1st Edition, 2004.
6. Buchanan, W., “Computer Busses”, CRC Press, 2000.
7. Petrezeulla, “Programmable Controllers”, McGraw-Hill, 2004.
8. Lucas, M.P., “Distributed Control System”, Van Nastrand Reinhold Company, New York, 1986.
9. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes, 1st Edition, 2004.

IN 9115 PROCESS CONTROL AND INSTRUMENTATION LABORATORY L T P C
0 0 3 2

1. (a) Study of Process Control Training plant
   (b) Piping and Instrumentation diagram
2. Simulation of coupled parameter and Distributed parameter system.
3. Identification of linear dynamic model of a process using non parametric methods.
4. (a) Design and implementation PID Control scheme on simulated process.
   (b) PID Implementation issues
5. Level and pressure control (with and without Interaction) in process control Test Rig.
6. (a) Auto- Tuning of PID controller
   (b) Design and implementation of gain scheduled Adaptive controller on the simulated model of variable area tank process.
7. Design and implementation of Feed forward and Cascade control schemes on the simulated model of CSIR process.
8. (a) Analysis of MIMO system.
   (b) Design and implementation of Multi-loop PID and Multivariable PID control schemes on the simulated model of two-tank systems.
9. Design and implementation of Robust PID control schemes on the simulated model of variable area tank process.
11. Design and implementation of Self tuning and Model Reference Adaptive Control schemes on the simulated model of variable area tank process.

P = 45 TOTAL= 45

IN 9121 ADVANCED PROCESS CONTROL **L T P C**
3 0 0 3

MULTIVARIABLE SYSTEMS **9**

Multivariable Systems – Transfer Matrix Representation – State Space Representation – Poles and Zeros of MIMO System - Multivariable frequency response analysis - Directions in multivariable systems - Singular value decomposition

MULTI-LOOP REGULATORY CONTROL **9**

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs - The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method - Decoupling Control – LQG Control – RGA for Non-square Plant

MULTIVARIABLE REGULATORY CONTROL **9**

Introduction to Multivariable control –Multivariable PID Controller -Multivariable IMC– Multivariable Dynamic Matrix Controller -Multivariable Model Predictive Control – Generalized Predictive Controller – Multiple Model based Predictive Controller – Constrained Model Predictive Controller - Implementation Issues

CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS **9**

Models for Time-varying and Nonlinear systems – Input signal design for Identification – Real-time parameter estimation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Nonlinear PID Controller - Control of Hammerstein and Wiener Systems

CASE –STUDIES **9**

Control Schemes for Distillation Column, CSTR, Bioreactor, Three-tank hybrid system, Four-tank system, pH, and polymerization reactor

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
3. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.
4. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw -Hill nternational Edition, 2004.
5. E. Ikonen and K. Najim, “ Advanced Process Identification and Control”, Marcel Dekker, Inc. Newyork, 2002
6. P. Albertos and S. Antonio, “ Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2004
7. Sigurd Skogestad, Ian Postlethwaite, **“**Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, 2004.

8. Lyuben, W.L.: Process Modelling, Simulation and Control,. McGraw- Hill, N.Y. (1990).

IN 9122 APPLIED SOFT COMPUTING **L T P C**
3 0 0 3

1.OVERVIEW OF ARTIFICIAL NEURAL NETWORK (ANN) & FUZZY LOGIC 9

Review of fundamentals - Biological neuron, Artificial neuron, Activation function, Single Layer Perceptron – Limitations – Multi Layer Perceptron – Back propagation algorithm (BPA); Fuzzy set theory – Fuzzy sets – Operation on Fuzzy sets - Scalar cardinality, fuzzy cardinality, union and intersection, complement (yager and sugeno), equilibrium points, aggregation, projection, composition, decomposition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

2. NEURAL NETWORKS FOR MODELLING AND CONTROL 9
Modeling of non linear systems using ANN- NARX,NNSS,NARMAX - Generation of training data - optimal architecture – Model validation- Control of non linear system using ANN- Direct and Indirect neuro control schemes- Adaptive neuro controller – Familiarization of Neural Network Control Tool Box.

3. ADVANCED ANN STRUCTURES AND ONLINE TRAINING ALGORITHMS 9
Recurrent neural network (RNN)- Adaptive resonance theory (ART)based network- Radial basis function network- - Online learning algorithms: BP through time – RTRL algorithms – Least Mean square algorithm - Reinforcement learning.

4. FUZZY LOGIC FOR MODELLING AND CONTROL 9
Modeling of non linear systems using fuzzy models –TSK model - Fuzzy Logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification –– Adaptive fuzzy systems – Familiarization of Fuzzy Logic Tool Box.

5. HYBRID CONTROL SCHEMES 9
Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS – Fuzzy Neuron - Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm –Introduction to Support Vector Machine- Evolutionary Programming-Particle Swarm Optimization - Case study – Familiarization of ANFIS Tool Box.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Laurence Fausett, Fundamentals of Neural Networks, Prentice Hall, Englewood cliffs, N.J., 1992.
2. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw Hill Inc., 1997.
3. Goldberg, Genetic Algorithm in Search, Optimization, and Machine Learning, Addison Wesley Publishing Company, Inc. 1989.
4. Millon W.T., Sutton R.S., and Webrose P.J., Neural Networks for control, MIT Press, 1992.
5. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning Series), MIT Press, 2004.
6. Corinna Cortes and V. Vapnik, " Support - Vector Networks, Machine Learning ”

1995.
7. Fuzzy Modeling and Fuzzy Control Series: Control Engineering Zhang, Huaguang, Liu, Derong, 2006

IN 9123 INSTRUMENTATION SYSTEM DESIGN **L T P C**
3 0 0 3

DESIGN OF SIGNAL CONDITIONING CIRCUITS **9**

Design of V/I Converter and I/V Converter- Analog and Digital Filter design – Signal conditioning circuit for pH measurement –Compensation circuit - Signal conditioning circuit for Temperature measurement - Cold Junction Compensation – software and Hardware approaches -Thermocouple Linearization – Software and Hardware approaches

DESIGN OF TRANSMITTERS **9**

RTD based Temperature Transmitter – Thermocouple based Temperature Transmitter- Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters.

DESIGN OF DATA LOGGER AND PID CONTROLLER **9**

Design of ON / OFF Controller using Linear Integrated Circuits- Electronic PID Controller – Microcontroller Based Digital PID Controller - Micro - controller based Data Logger – Design of PC based Data Acquisition Cards

ORIFICE AND CONTROL VALVE SIZING **9**

Orifice Sizing: - Liquid, Gas and steam services - Control Valves – Valve body:- Commercial valve bodies – Control valve sizing – Liquid, Gas and steam Services – Cavitation and flashing –Selection criteria – Rotameter Design.

DESIGN OF ALARM AND ANNUNCIATION CIRCUIT **9**

Alarm and Annunciation circuits using Analog and Digital Circuits – Thyristor Power Controller – Design of Programmable Logic Controller

TOTAL : 45 PERIODS

TEXT BOOKS

1. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2006.

2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.

3. R.W. Miller, “Flow Measurement Engineering Handbook”, Mc-Graw Hill, New York1996.

IN 9124 APPLIED INDUSTRIAL INSTRUMENTATION L T P C
3 0 0 3

1 Review of Industrial Instrumentation 9

Measurement of Force, Torque, Velocity, Acceleration, Pressure, Temperature, Flow, Level, Viscosity, Humidity & Moisture (Qualitative Treatment Only).

2 Measurement in thermal power plant 9

Selection, Installation and maintenance of Instruments used for the measurement of fuel flow, Air flow, Drum level, Steam pressure, Steam temperature and other parameters in thermal power plant – Analyzers-Dissolved Oxygen Analyzers- Flue gas Oxygen Analyzers-pH measurement- Coal/Oil Analyzer – Pollution Controlling Instruments

3 Measurement in Petrochemical Industry 9

Parameters to be measured in refinery and petrochemical industry-Temperature, Flow and Pressure measurements in Pyrolysis, catalytic cracking, reforming processes-Selection and maintenance of measuring instruments – Intrinsic safety.

4 Instrumentation for energy conservation & management and safety 9

Principle of energy audit, management & conservation and measurement techniques –Instrumentation for renewable energy systems – Energy management device (Peak load shedding) - Electrical and intrinsic safety - Explosion suppression and deluge systems – Flame arrestors, conservation vents and emergency vents – Flame, fire and smoke Detectors- Metal detectors.

5 Special Purpose Instrumentation 9

Toxic gas monitoring- Detection of Nuclear radiation – Water quality monitoring-Monitor measurement by neutron-Thermo-luminescent detectors – Measurement of length, mass, thickness, flow, level using nuclear radiation.

TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.
2. John G Webster, Measurement, Instrumentation and Sensors Handbook, CRC press IEEE press
3. Liptak B.G, Instrumentation Engineers Handbook (Measurement), Chilton Book Co., 1994.
4. Reay D.A, Industrial Energy Conservation, Pergamon Press,1977.
5. Hodge B.K, Analysis and Design of energy systems, Prentice Hall, (1988).
6. Liptak B.G, Instrument Engineers Handbook, Clinton Book Company, (1982)
7. Ness S.A. Air monitoring for Toxic explosions, Air integrated Approach, Von Nostrand

(1991).
8. Ewing G., Analytical Instrumentation hand book, Dekker (1991).
9. Alans V., Water and Waste water examination manual, Lewis Chele

IN 9125 INDUSTRIAL AUTOMATION LABORATORY L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. DISTRIBUTED CONTROL SYSTEM - DEMONSTRATION
2. ON-LINE MONITORING AND CONTROL USING DCS
3. ON-LINE MONITORING AND CONTROL USING VIRTUAL INSTRUMENTATION PACKAGE
4. CONTROL OF LEVEL PROCESS USING EMBEDDED CONTROLLER.
5. DEVELOPMENT OF VIRTUAL INSTRUMENT USING SCADA PACKAGE
6. IMPLEMENTATION OF DISCRETE CONTROL SEQUENCE USING PROGRAMMABLE LOGIC CONTROLLER
7. IMPLEMENTATION OF CONTINUOUS CONTROL SEQUENCE USING STAND ALONE PROGRAMMABLE CONTROLLER
8. STUDY OF NETWORKED CONTROL SYSTEM
9. PREPARATION OF DOCUMENTATION OF INSTRUMENTATION PROJECT. (PROCESS FLOW SHEET, INSTRUMENT INDEX SHEET AND INSTRUMENT SPECIFICATION SHEET).
10. PREPARATION OF PROJECT SCHEDULING, INSTALLATION PROCEDURE AND SAFETY REGULATIONS.

P = 45 Total= 45

IN 9131 PROJECT WORK (PHASE I) 0 0 12 6

IN 9141 PROJECT WORK (PHASE – II) 0 0 24 12

IN 9151 THERMAL POWER PLANT INSTRUMENTATION **L T P C**
3 0 0 3

1. Basics of thermal power plant **9**

Process of power generation in coal – fired and oil-fired thermal power plants- Types of Boilers- Combustion process – Superheater – Turbine – Importance of Instrumentation in thermal power plants

2. Boiler control **9**

Combustion control-Air/fuel ratio control-furnace draft control –Drum level control – Steam temperature Control – Attemperator – DCS in power plant – Interlocks in Boiler operation**.**

3. Turbine monitoring and control **9**

Measurement of speed, vibration, shell temperature of steam turbine – Steam pressure Control – Speed control of turbine – Alternator- Monitoring voltage and frequency – Operation of several units in parallel- Synchronization**.**

4. Boiler modeling and advanced control **9**

Development of mathematical model of combustion chamber, boiler drum and superheater – ANN based model – Model predictive control of superheater – control of drum level using AI techniques.

5. Optimization of thermal power plant operation **9**

Determination of Boiler efficiency – Heat losses in Boiler – Effect of excess air – Optimizing total air supply- Combustible material in ash- Reduction of turbine losses- Choice of optimal plant parameters- Economics of operation

TOTAL : 45 PERIODS

TEXT BOOK

1. A.B.Gill –Power Plant performance, Elsevier India, New Delhi,2003

REFERENCES

1.S.M.Elonko and A.L.Kohal –Standard Boiler Operations, McGraw Hill, New Delhi, 1994

2.Sam G. Duke low -The Control of Boiler, ISA press, 1991

3.R.K.Jain -Mechanical and Industrial Measurements, Khanna publishers, New Delhi, 1995.

IN 9152	SYSTEM THEORY	L T P C 3 0 0 3

1. FREQUENCY DOMAIN DESCRIPTIONS 9

Properties of transfer functions - poles and zeros of transfer function matrices – singular value analysis – Multivariable Nyquist plots.

2. STATE SPACE APPROACH 9

Review of state model for systems – State transition matrix and its properties – free and forced responses – controllability and observability – Kalman decomposition – minimal realization – balanced realization.

3. STATE FEEDBACK CONTROL AND STATE ESTIMATOR 9

State Feedback – Output Feedback – Pole placement technique – Full order and Reduced Order Observers – Deadbeat Observers – Dead beat Control

4. NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Phase plane analysis (analytical and graphical methods) – Limit cycles – Equivalent Linearization – Describing Function Analysis, Derivation of Describing Functions for different non-linear elements.

5. STABILITY OF NON-LINEAR SYSTEMS 9

Stability concepts – Equilibrium points – BIBO and Asymptotic stability – Stability Analysis by DF method – Lyapnov Stability Criteria – Krasovskil's method – Variable Gradient Method – Popov's Stability Criterion.

TOTAL : 45 PERIODS

REFERENCES

1. M.Gopal, "Modern Control System Theory", Wiley Eastern Limited, 2nd edition, 1996.
2. K.Ogata, "Modern Control Engineering", PHI, 3rd Edition, 1997.
3. M.Gopal, "Control System Principles and Design", 2nd Edition, 2002.
4. W. L. Luyben, "Process Modeling, simulation and control for Chemical Engineers", 2nd edition, McGraw Hill.
5. D.P.Atherton, "Stability of non linear systems", Prentice Hall, 1986.

IN 9153 APPLIED BIOMEDICAL INSTRUMENTATION **L T P C**
3 0 0 3

I. INTRODUCTION TO BIOMEDICAL MEASUREMENTS **9**

Physiological systems and measurable variables- Nature and complexities of biomedical measurements- Medical equipment standards- organization, classification and regulation- Biocompatibility - Human and Equipment safety – Physiological effects of electricity, Micro and macro shocks, thermal effects.

II .ADVANCES IN MODELING AND SIMULATIONS IN BIOMEDICAL INSTRUMENTATION **9**

Modeling and simulation in Biomedical instrumentation – Difference in modeling engineering systems and physiological systems – Model based analysis of Action Potentials - cardiac output – respiratory mechanism - Blood glucose regulation and neuromuscular function.

III. BIOMEDICAL SIGNALS AND THEIR ACQUISITIONS **9**

Types and Classification of biological signals – Signal transactions – Noise and artifacts and their management - Biopotential electrodes- types and characteristics - Origin, recording schemes and analysis of biomedical signals with typical examples of Electrocardiography(ECG), Electroencephalograhy(EEG), and Electromyography (EMG)– Processing and transformation of signals-applications of wavelet transforms in signal compression and denoising.

IV. INSTRUMENTATION FOR DIAGNOSIS AND MONITORING **9**

Advanced medical imaging techniques and modalities -Instrumentation and applications in monitoring and diagnosis- Computed tomography, Magnetic Resonance Imaging and ultrasound- Algorithms and applications of artificial intelligence in medical image analysis and diagnosis-Telemedicine and its applications in telemonitoring.

V. BIOMEDICAL IMPLANTS AND MICROSYSTEMS **9**

Implantable medical devices: artificial valves, vascular grafts and artificial joints-cochlear implants - cardiac pacemakers – Microfabriation technologies for biomedical Microsystems- microsensors for clinical applications – biomedical microfluid systems

TOTAL : 45 PERIODS

REFERENCES:

1. John G.Webster (editor), Bioinstrumentation, John Wiley & Sons, 2004.
2. Shayne Cox Gad, Safety Evaluation of Medical Devices, Marcel Deckle Inc, 2002.
3. Michael C. K. Khoo, Physiological Control Systems- Analysis Simulation and Estimation, 2001.
4. John G.Webster (editor), Medical Instrumentation Application and design, John Wiley & Sons, 2005.
5. Cromwell l., Biomedical Instrumentation and Measurements, Prentice Hall of India, 1995.
6. Rangaraj M.Rangayan, Biomedical signal analysis, John Wiley & Sons (ASIA) Pvt. Ltd.,
7. Kayvan najarian and Robert splinter, Biomedical Signal and Image Processing, CRC Press, 2005.
8. John M.Semmlow, Biosignal and Bio medical Image processing, CRC Press, 2004.
9. Joseph J. Carr and John M Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004
10. Strong P, Biophysical measurements, Tektronix Inc 1997.

IN 9154 CRYPTOGRAPHY AND NETWORK SECURITY L T P C
3 0 0 3

9

1. INTRODUCTION AND NUMBER THEORY

Classic Cipher Techniques – Substitution Ciphers, Mono-alphabetic Substitution and Poly-alphabetic Substitution – Transposition Ciphers.

Number Theory and Finite Arithmetic, Counting in Modulus ρ Arithmetic, Congruence Arithmetic, Fermat's Theorem and Euler's Theorem- Exponentiation.

2.SINGLE AND PUBLIC KEY CIPHERS 9

DES - 3DES – AES – RSA Algorithm, ElGamal Algorithm – Key Management using Exponential Ciphers - Diffie-Hellman.

3.MESSAGE AUTHENTICATION, DIGITAL SIGNATURES AND CERTIFICATES 9

Security Services and Mechanisms – Message Authentication (Integrity) – MAC – Hash Functions – Digital Signature: Digital Signature Standards (FIPS 186-2), DSA (ANSI X9.30), RSA (ANSI X9.31) – RSA Certification –PKI Certificates.

4.TRUSTED IDENTITY AND WIRELESS SECURITY 9

Security Concerns – Password System: Fixed and One time Passwords (S/Key) RFC 2289 – Callback Systems, Challenge and Response Systems – RADIUS – Kerberos v4 & v5 – Needham Schroeder Protocol – ITU-T X.509 – Authentication: Framework, Simple, Protected, Strong – PKI Life Cycle Management - Current Wireless Technology - Wireless Security WEP Issues.

5.PROTOCOLS AND FIREWALLS 9

SSL/TLS - SSH - IPSec – Firewall Concepts, Architecture, Packet Filtering, Proxy Services and Bastion Hosts – Electronic Mail Security – PGP, S/MIME.

TOTAL : 45 PERIODS

REFERENCES:

1) "Cryptography and Network Security: Principles and Practice", William Stallings, 3rd Edition, Pearson Education, 2002.
2) "Network Security Essentials: Applications and Standards", William Stallings, 2nd Edition, Pearson Education, 2000.
3) "Cryptography and Network Security", Behrouz A.Forouzan, special edition, Tata McGraw Hill, 2007.
4) "Applied Cryptography", Bruce Scheneier, John Wiley & Sons, 1994.
5) "Cryptography: Theory and Practice", Douglas R.Stinson, CRC Press Series on Discrete Mathematics and its Applications, 1995.

IN 9155 VLSI SYSTEM DESIGN L T P C
3 0 0 3

UNIT I BASIC DEVICE CHARACTERISTICS 9

NMOS, PMOS, enhancement and depletion mode transistor, MOSFET threshold voltage, linear and saturated operation, standard CMOS inverter, transit time and switching speed of NMOS and CMOS inverters, NMOS and CMOS gates, transistor sizing and power dissipation, noise margin calculations, Device models for simulation, CMOS device fabrication principles, SPICE models and circuit simulation using PSPICE

UNIT II DESIGN RULES AND LAYOUT 9

Purpose of design rules, NMOS and CMOS design rules and layout, Design of NMOS and CMOS inverters, NAND and NOR gates. Interlayer contacts, butting and buried contacts, stick diagrams, layout of integrated circuits.

.

UNIT III DESIGN OF BASIC VLSI CIRCUITS 9

Design of circuits like multiplexer, decoder, priority encoder, Flip flops, shift registers CMOS circuits, Construction of Transmission gates, Adder, Multiplier ,Shifters and Accumulators.

UNIT IV FPGAs AND CPLDs 9

Introduction. FPGA Architectures. SRAM-Based FPGAs. Permanently Programmed FPGAs. Chip I/O, Introduction to CPLDs Comparison of FPGAs and CPLDs from Xilinx, Altera and Actel. Introduction to ASIC.

UNIT V PRINCIPLES OF HDL 9

VHDL design Entity- Signal and Variable – Using Subcircuits - Concurrent Assignment Statements – Sequential Assignment Statements – Combinational and Sequential circuits. High level VLSI synthesis and design tools including Mentor Graphics with CAD algorithm overview for floor planning,placement and routing. Realizing PID controller in VHDL. Introduction to Analog and mixed signal processing.

REFERENCES

1. Jan M.Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated circuits – A design perspective, Second Edition, Prentice hall of India ,2003.
2. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with VHDL design, International edition 2000.
3. Michael John Sebastian Smith, Application-Specific Integrated Circuits, Addison-Wesley, June 1997.
4. Uyemura, John P, Introduction to VLSI Circuits and Systems,1st Edition ,John Wiley and sons,2001.
5. Wayne Wolf, FPGA – Based System Design, Prentice Hall , 2004.

IN 9156 OPTIMAL CONTROL **L T P C**
3 0 0 3

INTRODUCTION **9**

The performance measure and Linear Optimal Control, Standard regulator problem, The Hamilton-Jacobi-Bellman equation, Finite-time horizon problems, Regulators with a prescribed degree of stability, Asymptotic properties and quadratic weight selection.

1. DYNAMIC PROGRAMMING **9**

Principle of optimality - Recurrence relation of Dynamic programming, Computational procedure, The H-J-B equation and analytical results for discrete and continuous linear regulator problems.

2. THE CALCULUS OF VARIATIONS **9**

Fundamental concepts, Functionals of a single function and functionals involving several independent functions, Piecewise smooth extremals, Constrained extrema, Necessary condition for optimal control, Liregulator problems.

3. THE MINIMUM (MAXIMUM) PRINCIPLE **9**

Pontryagin's minimum principle and state inequality constraints, Minimum time problem, Minimum control energy problems, Relationship between Dynamic Programming and Minimum Principle, Singular intervals in optimal control.

4. CASE STUDIES **9**

Optimal control in selected applications – distillation column, boiler and paper manufacturing plant.

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Donald Kirk, Optimal Control Theory, Prentice Hall
2. B.D.O.Anderson and J.B.Moore, Optimal Control: Linear Quadratic Methods, Prentice Hall.
3. T.Basar and G.J.Olsder, Dynamic Noncorperative Game Theory, SIAM classics in Applied mathematics, 1999.
4. Andrew P.Sage and Chelsea C.White, Optimum Systems Control, 2nd edition, Prentice Hall, 1977.
5. D.P.Bertsekas, Dynamic Programming and Optimal Control,Vol.I, 2nd edition, Athena Scientific, 2000.
6. M.Athans and P.L.Falb, Optimal Control, McGraw Hill, 1966.
7. A.E.Bryson and Y.C.Ho, Applied Optimal Control, 2nd edition, Blaisdel, 1975.
8. L.B.Lee and L.Markus, Foundations of Optimal Control Theory, Wiley, 1967.

IN 9157	ROBUST CONTROL	L T P C 3 0 0 3

UNIT I **9**

Introduction-measure of robustness –robustness in stability and performance-plant uncertainty model- robustness of sampled-data control system.

UNIT II **9**

Analysis of robustness-stability analysis –gamma stability-testing sets –Kharitonov's theorem –stability radius

UNIT III **9**

Design of robust control system –root locus method-frequency response method-ITAE method –robust IMC system –Pseudo-quantitative feedback theory based robust controller.

UNIT IV **9**

Robust control design using H ∞ methods – H∞ control for linear and non-linear systems.

UNIT V **9**

Robust control for constrained systems –integral quadratic constraints and weighted quadratic constraints for linear systems – non-linear system with constraints –case study.

TOTAL : 45 PERIODS

REFERENCES

1. S.P.Bhattacharyya, H.Chapellat and L.H.Keel, Robust Control (The Parametric approach), Prentice Hall, New Jersy, 1995.

2. J.Ackerman, Robust control systems with uncertain physical parameters, Springer –Verlag, London, 1993.

3. L.R.Petersen, V.A.Ugrinovskii and A.V.Savkin, Robust control design using h∞ methods, Springer –London, 1993.

4. R.C.Dorf and R.H.Bishop, Modern Control Systems, Addison- Wesley, Delhi, 1999.

IN 9158 ROBOTICS AND AUTOMATION **L T P C**
3 0 0 3

INTRODUCTION AND ROBOT KINEMATICS (9)
Basic concepts of Robots and automation-classification-specifications-Application-Notation-Direct Kinematics-Co-ordinate frames-rotations-Homogeneous coordinates-The Arm equation-Kinematic analysis of a typical Robot -Inverse Kinematics -Tool configuration-Inverse kinematics of a typical Robot -Workspace analysis and trajectory planning-Work envelope of different robots-The pick and place operation

DYNAMIC OF ROBOTS (9)
Continuous path motion-interpolated motion-Straight line motion-Tool configuration Jacobian matrix and manipulator Jacobian-Manipulator Dynamics- -Kinetic of potential energy-Energized forces- Lagrange's Equation -Euler Dynamic model

ROBOT CONTROL (6)
The control problem-state equation-Single axis PID control-PD gravity control-Computed torque control-Variable Structure control-Impedance control

ROBOT VISION & MICRO ROBOTICS (12)
Fundamentals of Robot applications-Robot vision –Image representation-Template-matching-polyhedral objects-Shape analysis- Segmentation – Iterative processing - Robot cell design-Types of applications-material handling applications-Machine loading and unloading-spot welding-arc welding-spray painting-Micro Robotics and MEMS-Fabrication technology for micro robotics, Stability issues in legged robots, under actuated manipulators.

MOBILE ROBOTS AND CONTROL ISSUES (9)
Industrial automation-General layout-general configuration of an automated flow line-conveyor systems - major features – types - Roller, State wheel, Belt, Chain and overhead trolley-Inspection station with feedback loops to up steam workstations-shop floor control-3 phases-order scheduling

TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Koren, "Robotics for Engineers", McGraw Hill International Company. Tokyo 1995.
2. Vokotravotic, "Introduction to Robotics", Springer, 1985.
3. K.S.Fu, R.C.Gonzally, C.S.G. Lee , " Robotics Control, Sensing, Vision and Intelligent" , Mcgraw Hill Book Company,1997.
4. Robort J.Schilling, "Fundamentals of robotics- Analysis and Control, Prentice Hall of India Pvt. Ltd., 2002.
5. Saeed B.Nniku, "Introduction to robotics- Analysis, Systems, Application" Prentice Hall of India Pvt. Ltd., 2003.

IN 9159 SYSTEM IDENTIFICATION L T P C
3 0 0 3

INTRODUCTION 9

Dynamic systems, Models for Linear Time-invariant Systems, time varying systems and nonlinear systems, The system identification procedure, Non-parametric methods- Transient analysis, Frequency analysis, correlation analysis and spectral analysis.

PARAMETER ESTIMATION METHODS 9

Least square estimation – best linear unbiased estimation under linear constraints – updating the parameter estimates for linear regression models – prediction error methods: description of prediction methods – optimal prediction – relation between prediction error methods and other identification methods – theoretical analysis - Instrumental variable methods: Description of instrumental variable methods – Input signal design for identification

RECURSIVE IDENTIFICATION METHODS 9

The recursive least square method – the recursive instrumental variable methods- the recursive prediction error methods – Maximum likelihood.

CLOSED- LOOP IDENTIFICATION 9

Identification of systems operating in closed loop: Identifiability considerations – direct identification – indirect identification – joint input / output identification - Subspace methods for estimating state space models.

PRACTICAL ASPECTS OF IDENTIFICATION 9

Practical aspects: experimental conditions – drifts and de-trending – outliers and missing data – pre-filtering -robustness – Model validation and Model structure determination-case studies – Introduction to Nonlinear System Identification- Introduction to Control relevant System Identification.

TOTAL : 45 PERIODS

TEXT BOOK

1. Soderstorm T and Peter Stoica, System Identification, Prentice Hall International, 1989.

2. Ljung L, System Identification: Theory for the user, Prentice Hall, Englewood Cliffs, 1987.

3. E. Ikonen and K. Najim, " Advanced Process Identification and Control", Marcel Dekker, Inc. Newyork, 2002.

IN 9160 ADVANCED OPERATING SYSTEMS **L T P C**
3 0 0 3

1. OPERATING SYSTEM **(9)**

Introduction - operating systems and services – CPU Scheduling approaches – Process synchronization Semaphores – Deadlocks – Handling deadlocks – Multithreading.

2. DISTRIBUTED SYSTEMS **(9)**

Introduction - Advantages of distributed system over centralized system, Limitations of Distributed system; Communication in Distributed systems – ATM, Client-Server model. Distributed operating system – Issues, Communication primitives – Message Passing Model, Remote Procedure Call.

3. SYNCHRONIZATION IN DISTRIBUTED SYSTEMS **(9)**

Clock synchronization –Lamport's logical clock, Vector clock, Causal ordering of messages, Causal Ordering of Messages; Mutual exclusion – Non token based and token based algorithm; atomic transactions; Distributed deadlock detection and prevention.

4. DISTRIBUTED RESOURCE MANAGEMENT **(9)**

Distributed file system – Trend, Design and Implementation; Distributed Shared Memory (DSM) – Memory coherence, Page based DSM, Shared variable DSM, Object based DSM; Distributed Scheduling.

5. FAILURE RECOVERY AND FAULT TOLERANCE **(9)**

Recovery – Classification, Backward and forward error recovery, Recovery in concurrent systems, synchronous checkpointing and recovery, Checkpointing for Distributed database system. Fault tolerant – commit protocols, Voting protocols, Dynamic vote reassignment protocol, Failure Resilient processes.

TOTAL : 45 PERIODS

REFERENCES:

1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education Asia, 1995.
2. Mukesh singhal and Niranjan G. Shivarathri, "Advanced Concepts in Operating Systems", Tata McGraw Hill, 1994..
3. Silberschatz, Galvin, "Operating System Concepts", John Wiley, 2003.
4. Stallings, "Operating system", PHI, New Delhi, 2004.

IN 9161 INSTRUMENTATION IN PETROCHEMICAL INDUSTRY **L T P C**
3 0 0 3

1. PETROLEUM PROCESSING **9**

Importance of petrochemical industry; Growth in India-Petroleum exploration-Recovery Techniques-Constituents of petroleum-oil-gas separation-Processing wet gases-Refining of crude oil-Refinery gases

2. CHEMICALS FROM PETROLEUM PRODUCTS **9**

Chemicals from petroleum -Methane derivatives- Acetylene derivatives- Ethylene derivatives- Propylene derivatives - Cyclic petrochemicals - Other Products

3. UNIT OPERATIONS IN PETROCHEMICAL INDUSTRY **9**

Important unit operations-Drying-Separation-Heat transfer-Distillation-Thermal cracking-catalytic cracking-catalytic reforming- hydro cracking – hydro treating -Chemical oxidation-Chemical reduction-Polymerisation-Alkylation-ISomerization-Production of Ethylene, Acetylene- and propylene from petroleum

4. MODELLING OF PETROCHEMICAL PROCESSES **9**

Modelling of refinery reactors - Dynamic modeling of catalytic cracking unit – catalytic reformer – modeling of crude distillation units – main fractionators.

5. CONTROL LOOPS IN PETROCHEMCIAL INDUSTRY **9**

Process control in refinery and petrochemical industry-Control of distillation column, catalytic cracking unit, catalytic reformer, pyrolysis unit-Automatic control of polyethylene production-Control of vinyl chloride and PVC production-Optimal control of cracking units and reformers.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Balchan .J.G. and Mumme K.L., Process Control Structures and applications, Van Nostrand Reinhold Company, New York, 1998.
2. Waddams A.L, Chemical from petroleum, Butter and Janner Ltd., 1968.

REFERENCES

1. Austin G.T. Shreeves, Chemical Process Industries, McGraw-Hill International student edition, Singapore, 1985.
2. Liptak B.G. Instrumentation in process industries, Chilton book Company, 1994.
3. Liptak B.G., Process measurement and analysis, Third edition, Chilton book Company, 1996.

IN 9162 INDUSTRIAL DRIVES AND CONTROL **L T P C**
3 0 0 3

INTRODUCTION TO ELECTRIC DRIVES **9**

Motor-Load system –Dynamics, load torque, steady state stability, speed control and multiqudrant operation –speed Torque characteristics of DC motor –breaking of series and separately excited dc motor, speed torque characteristics of induction motor

MODELING OF AC AND DC MACHINES **9**

Circuit model of Electric Machines-Transfer function models of series and separately excited DC motor-AC Machines –Dynamic modeling –linear transformations-equations in stator, rotor and synchronously rotating reference frames-flux linkage equations-Dynamic state space model-modeling of Synchronous motor

CONTROL OF DC DRIVES **9**

Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations- Analysis of series and separately excited DC motor fed from different choppers, effect of saturation in series motors-Closed loop control of dc drives-two quadrant and four quadrant operation

CONTROL OF AC DRIVES **9**

Operation of induction motor with non-sinusoidal supply waveforms, Variable frequency operation of 3-phase inductions motors, constant flux operation, current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives, Torque Equations, Constant torque operations, Static rotor resistance control and slip power recovery scheme –Combined stator voltage control and rotor resistance control-Synchronous motor control, control of stepped motors.

ADVANCED CONTROL OF AC DRIVES **9**

Principles of vector control –Direct and indirect vector control of induction motor –DTC-sensor less vector control-speed estimation methods-Applications of Fuzzy logic and Artificial Neural Network for the control of AC drives

TOTAL : 45 PERIODS

REFERENCES

1. Bimal K Bose Modern Power electronics and AC Drives,"Pearson education asia 2002.
2. Dubey, G.K "Power Semiconductor Controlled Drives," Prentice Hall International, New Jersey, 1989.
3. Krishnan. R, "Electrical Motor Drives- Modeling, Analysis and Control "Prentice Hall of India Pvt Ltd., 2nd Edition , 2003.
4. "Analysis of Electric Machinery and Drive Systems" Paul .C.Krause, Oleg wasyncznk, Scott.D.Sudhoff, 2nd edition , Wiley Interscience, John wiley & Sons, 2002.
5. Werner Leonard, Control of Electrical Drives' 3rd edition, Springer,2001.

IN 9163 STATE ESTIMATION **L T P C**
3 0 0 3

INTRODUCTION TO STATE ESTIMATION AND KALMAN FILTER **9**

Review of Matrix Algebra and Matrix Calculus and Probability Theory – Least Square Estimation – Review of state observers for Deterministic System- Derivation of the Discrete – time Kalman filter – Kalman filter properties- Kalman filter generalization: - Correlated Process and Measurement Noise – Case Studies

EXTENDED KALMAN FILTER **9**

Linearized Kalman filter – Extended Kalman filter – The iterated Extended Kalman filter – The Second order Extended Kalman filter – Constrained Extended Kalman filter- Case Studies

UNSCENTED KALMAN FILTER **9**

Means and Covariance of non-linear transformations – Unscented transformation – Unscented Kalman filtering -General - Unscented transformation - The simplex Unscented transformation – Spherical Unscented transformation - Constrained Unscented Kalman filter – Case Studies

THE H-INFINITY FILTER **9**

The H**-** infinity filter -Introduction - Kalman filter Limitations - A game theory Approach to H**-** infinity filtering – Steady state H**-** infinity Filtering -Mixed Kalman / H**-** Infinity filtering - Robust Kalman / H**-** infinity filtering - Constrained H**-** infinity filtering – Case Studies

PARTICLE FILTER **9**

Bayesian state Estimation - Particle filtering - Implementation issues: - Sample Impoverishment - Particle filter with EKF as proposal - Unscented Particle filter - Case Studies

TOTAL : 45 PERIODS

TEXT BOOKS

1. Branko Ristic, Sanjeev Arulampalam, Neil Goodon, “Beyond the Kalman Filter: Particle ilters for Tracking Application” Artech House Publishers, Boston, London, 2004.
2. Dan Simon, “Optimal State Estimation Kalman, H-infinity and Non-linear Approaches”, John Wiley and Sons, 2006.

IN 9164 ADVANCED DIGITAL SIGNAL PROCESSSING **L T P C**
3 0 0 3

FREQUENCY DOMAIN ANALYSIS OF SIGNALS AND SYSTEM AND DIGITAL FILTERS (9)

Introduction, Discrete time Fourier Transform – Frequency response of LTI systems, Discrete Fourier Transform, Fast Fourier Transform Algorithms – Decimation in time and Decimation in Frequency algorithm, Digital Filters – Introduction FIR filter, IIR filter.

RANDOM SIGNAL PROCESSING AND SPECTRUM ESTIMATION (9)

Discrete Random Processes, Expectations, Variance, Parseval's Theorem, Wiener Khintchine Relation - Power Spectral Density - Periodogram – Sample Autocorrelation - Sum Decomposition Theorem, Spectral Factorization Theorem Non-Parametric Methods-Correlation Method - Co-Variance Estimator - Consistent Estimators-Periodogram Estimator-Barlett Spectrum Estimation-Welch Estimation-Model based Approach - AR, MA, ARMA signal Modeling-Parameter Estimation using Yule-Walker Method.

LINEAR ESTIMATION AND PREDICTION (9)

Maximum likelihood criterion-efficiency of estimator-Least mean squared error criterion - Wiener filter-DiscreteWiener Hoff equations-Recursive estimators-Kalman filter-Linear prediction, prediction error-whitening filter, inverse filter-Levinson recursion, Lattice realization, and Levinson recursion algorithm for solving Toeplitz system of equations.

ADAPTIVE FILTERS (9)

FIR adaptive filters-Newton's steepest descent method - adaptive filter based on steepest descent method- Widrow Hoff LMS adaptive algorithm- Adaptive channel equalization-Adaptive echo chancellor-Adaptive noise cancellation-RLS adaptive filters-Exponentially weighted RLS-sliding window RLS-Simplified IIR LMS adaptive filter.

MULTIRATE DIGITAL SIGNAL PROCESSING (9)

Mathematical description of change of sampling rate - Interpolation and Decimation - continuous time model - Direct digital domain approach - Decimation by an integer factor - Interpolation by an integer factor - Single and multistage realization - poly phase realization - Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

TOTAL : 45 PERIODS

REFERENCES:

1. Monson H.Hayes, " Statistical Digital Signal Processing and Modeling ", John Wiley and Sons, Inc., New York, 1996.
2. Sopocles J.Orfanidis, " Optimum Signal Processing ", McGraw Hill, 1990.
3. John G.Proakis, Dimitris G.Manolakis, " Digital Signal Processing ", Prentice Hall of India, 1995.

IN 9165 WIRELESS SENSOR NETWORKS **L T P C**
3 0 0 3

1.INTRODUCTION **9**

Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks.

2.PHYSICAL LAYER **9**

Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication , packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management .

3.DATA LINK LAYER **9**

MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols –fundamentals task and requirements ,error control ,framing, link management

4.NETWORK LAYER **9**

Gossiping and agent-based uni-cast forwarding , Energy-efficient unicast, Broadcast and multicast, geographic routing , mobile nodes, Data –centric and content-based networking –Data –centric routing, Data aggregation, Data-centric storage, Higher layer design issue

5.CASE STUDY **9**

Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Sensor Network Platforms and tools-Sensor node hardware, Node-level software platforms, node –level simulators.

TOTAL : 45 PERIODS

REFERENCES:

1. Wireless Sensor Networks: an information processing approach – Feng zhao, Leonidas guibas, Else vier publication, 2004.
2. Wireless Sensor Networks –C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, Springer publication, 2004.
3. Wireless Sensor Networks : Architecture and protocol –Edgar H .Callaway, CRC press.
4. Protocol and Architecture for Wireless Sensor Networks –Holger Karl , Andreas willig John wile y publication, Jan 2006.
5. Wireless Sensor Networks: First European workshop, EWSN 2004, Berlion, germany, January 2004 proceedings –Holger Karl , Andreas willig,Adam holisz,Springer publication.
6. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
7. Jamal N. Al-karaki, Ahmed E. Kamal, " Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

IN 9166 **BIOSIGNAL PROCESSING** **L T P C**
3 0 0 3
9

Sources of Biomedical signals, types of signals – Deterministic, stochastic, fractal and chaotic, auto correlation, cross correlation, auto covariance, DFT, FFT algorithm – Digital filters – Introduction to FIR and IIR filter.

CLASSICAL SPECTRAL ESTIMATION TECHNIQUES **9**

Periodogram, Blackman – Tukey spectral Estimation applications – analysis of the Doppler signal using the Periodogram, analysis of Auditory Evoked potentials (AEP) using periodogram, analysis of Heart rate variability using the periodogram cepstrum anlaysis – Cepstra, power cepstrum, applications of cepstrum analysis – analysis of the ECG signal using cepstrum technique, analysis of Diastolic Heart sound using cepstrum technique.

ADAPTIVE NOISE CANCELLATION **9**

Introduction, principle of adaptive noise canceling, adaptive Noise cancellation with the LMS and RLS adaptation algorithm - applications – adaptive noise canceling method to enhance ECG monitoring, adaptive noise canceling method to enhance Fetal ECG monitoring, adaptive noise canceling method to enhance Electro gastric measurements.

PARAMETRIC MODELING METHODS **9**

Autoregressive (AR) methods – Linear Prediction and Autoregressive methods, the autocorrelation (Yule - walker) methods, applications of AR methods AR modeling of seizure EEG, ECG signals and surface EMG. Autoregressive Moving Average (ARMA) method – MLE method, Akaike method, Durbin method, applications – ARMA modeling of somatosensory Evoked Potentials (SEPs), Diastolic Heart sounds and cutaneous Electro gastric signals.

NON LINEAR BIOSIGNAL PROCESSING AND WAVELET TRANSFORM 9

Clustering methods – hard and fuzzy clustering, applications of Fuzzy clustering to Biomedical signal processing, Neural Networks – Introduction – NN in processing and analysis of Biomedical signals wavelet transform – Introduction, Filter bank implementation of discrete wavelet transform, signal Denoising using wavelet transform, wavelet based compression.

TOTAL : 45 PERIODS

REFERENCES

1. M.Akay, 'Biomedical Signal Processing' Academic Press, San Diego, 1994.
2. M.Akay, Nonlinear Biomedical Signal Processing, Fuzzy Logic, Neural Networks and New Algorithms (vol1) (IEEE Press series on Biomedical Engineering)
3. Eugene.N. Bruce, 'Biomedical Signal Processing and Signal Modeling', Wiley publications 2000.

IN 9167 FAULT DETECTION AND DIAGNOSIS L T P C
3 0 0 3

INTRODUCTION TO FAULT DETECTION AND DIAGNOSIS (FDD) 9

Scope of FDD:- Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances - Different issues involved in FDD-Typical applications.

ANALYTICAL REDUNDANCY CONCEPTS: 9

Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

DESIGN OF STRUCTURED RESIDUALS: 9

Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

DESIGN OF DIRECTIONAL STRUCTURED RESIDUALS: 9

Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation- Introduction of Residual generation of parametric fault – Robustness Issues- Statistical Testing of Residual generators

DATA DRIVEN METHODS 9

Principal Component Analysis – Partial Least Squares - Canonical Variate Analysis – Knowledge Based Methods.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Janos J. Gertler, "Fault Detection and Diagnosis in Engineering systems" – Second Edition, Marcel Dekker, 1998.

REFERENCE BOOKS:

1. L.H. Chiang, E.L. Russell and R.D. Braatz, "Fault Detection and Diagnosis in Industrial Systems" – Springer-Verlag-London 2001.
2. Rami S. Mangoubi. "Robust Estimation and Failure detection". Springer-Verlag-London 1998.
3. **R. Isermann,** Fault-Diagnosis Systems An Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2006

IN 9168 VIRTUAL INSTRUMENTATION L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III DATA ACQUISITION 9

Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements – Issues involved in selection of Data acquisition cards – Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV VI TOOLSETS **9**

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory

UNIT V APPLICATIONS **9**

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. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis, Lab VIEW for everyone, Prentice Hall, New Jersey, 1997.

REFERENCES:

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

IN 9169 ADAPTIVE CONTROL **L T P C**
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INTRODUCTION **9**

Introduction- Adaptive Schemes- The adaptive Control Problem- Applications- Real-time parameter estimation: - Least squares and regression methods- Estimating parameters in dynamical systems

GAIN SCHEDULING **9**

Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations -application of gain scheduling - Auto-tuning techniques:- Methods based on Relay feedback

DETERMINISTIC SELF-TUNING REGULATORS **9**

Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics

STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS **9**

Introduction – Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators

MODEL – REFERENCE ADAPTIVE SYSTEM 9

Introduction- MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR

TOTAL: 45 PERIODS

TEXT BOOK

1. K.J. Astrom and B. J. Wittenmark, “Adaptive Control”, Addison-Wesley Publishing House, 1995.

2. T. Soderstorm and Peter Stoica, “System Identification”, Prentice Hall International, 1989.

3. Ljung L, “System Identification: Theory for the user”, Prentice Hall, Englewood Cliffs, 1987.