St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.E. (INSTRUMENTATION ENGINEERING)

(I TO IV SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2008)

St. PETER'S UNIVERSITY

Chennai 600054

M.E (INSTRUMENTATION AND ENGINEERING)

Regulations and Syllabi

(Effective 2008)

1. **Eligibility:** Candidates who passed B.E / B.Tech. (Electrical and Electronics Engineering / Electronics communication Engineering / Electronics Instrumentation Engineering / Instrumentation and control engineering / Electronics Engineering / Instrumentation & Engineering / Mechatronics Engineering / Biomedical Engineering / Bio medical Instrumentation Engineering / Applied Electronics and Instrumentation Engineering / Electronics and Control Engineering) of the University or any other equivalent examination thereto are eligible for admission to Two Year M.E. (Instrumentation engineering) Programme.

2. **Duration:** Two Years Comprising 4 Semester. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Continuous and end Assessment:** The Weightage for Continuous Assessment (CA) and End Assessment (EA)be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations .

5. **Credit System :** Credit system be followed with 18 credits for each semester and each credit is equilent to 25-30 hours of effective study provided in the Time Table.

6. Scheme of Examinations

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
108IEPT01	Applied Mathematics	3	25	75	100
108IEPT02	Process Control	3	25	75	100
108IEPT03	Transducers and Smart Instruments	3	25	75	100
108IEPT04	Real Time Embedded System	3	25	75	100
	Elective—I	2	25	75	100
	Elective—II	2	25	75	100
PRACTICAL					
108IEPP01	Process Control and Instrumentation Laboratory	2	25	75	100
	TOTAL	**18**			

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
208IEPT01	Industrial Instrumentation	3	25	75	100
208IEPT02	Logic and Computer Control	3	25	75	100
208IEPT03	Computer Networks and DCS	3	25	75	100
208IEPT04	Neural and Fuzzy Logic Control Systems	3	25	75	100
	Elective — III	2	25	75	100
	Elective — IV	2	25	75	100
PRACTICAL					
208IEPP01	Modeling and Simulation Laboratory	2	25	75	100
	TOTAL	**18**			

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
	Elective—V	3	25	75	100
	Elective—VI	3	25	75	100
	Elective—VII	3	25	75	100
PRACTICAL					
308IEPP01	Project work (Phase-I)*	9	25	65	100
	Viva voce			10	
	TOTAL	**18**	**100**	**300**	**400**

***** Candidates who have completed Project work (Phase I) successfully are eligible for Project Work (Phase - II) Examination.

IV Semester

Code No.	Course Title	Credit	Marks		
Project			**CA**	**EA**	**TOTAL**
408IEPP01	Project work (Phase -II)	18	25	65	100
	Viva voce			10	
	Total	18	25	75	100

ELECTIVES FOR M.E. INSTRUMENTATION ENGINEERING

Semester	Course Code	Course Title	C	CA	EA	T
I	108IEPE01	System Identification and Adaptive Control	2	25	75	100
	108IEPE02	Fiber Optic and Laser Instrumentation	2	25	75	100
	108IEPE03	Java and Visual Programming	2	25	75	100
	108IEPE04	Power Plant Instrumentation	2	25	75	100
	108IEPE05	System Theory	2	25	75	100
	108IEPE06	Digital Signal Processing	2	25	75	100
	108IEPE07	Image Processing & Pattern Recognition	2	25	75	100
II	208IEPE01	Analytical Instrumentation	2	25	75	100
	208IEPE02	Optimal Control	2	25	75	100
	208IEPE03	Bio-Medical Instrumentation	2	25	75	100
	208IEPE04	Multivariable Control	2	25	75	100
	208IEPE05	Operating Systems	2	25	75	100
	208IEPE06	Advanced Digital Signal Processing	2	25	75	100
III	308IEPE01	Robust Control	2	25	75	100
	308IEPE02	Virtual Instrumentation	2	25	75	100
	308IEPE03	Instrumentation in Pulp and Paper Industry	2	25	75	100
	308IEPE04	Physiological Control Systems	2	25	75	100
	308IEPE05	Industrial Drives and Control	2	25	75	100
	308IEPE06	Data Security and Cryptography	2	25	75	100
	308IEPE07	VLSI System Design	2	25	75	100
	308IEPE08	Wireless Networks	2	25	75	100
	308IEPE09	Fault Tolerant Control	2	25	75	100

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it its specifically mentioned in the scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\,C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus).Each question carries 2 marks.

Part B: 5 question with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

Registrar

10. Syllabus

108IEPT01 APPLIED MATHEMATICS

FOR INSTRUMENTATION ENGINEERS

1. CALCULUS OF VARIATION

Introduction — Euler's equation — several dependent variables Lagrange's equations ofDynamics — Integrals involving derivatives higher that the first — Problems with constraints — Direct methods and eigen value problems.

2. MATRIX THEORY .

Eigen values using QR transformations — generalized eigenvectors — canonical forms — singular value decomposition and applications — pseudo inverse — least square approximations.

3. NONLINEAR ORDINARY DIFFERENTIAL EQUATION

Introduction — Equations, with separable variables — Equations reducible to linear form — Bernoullis equation — Riccati's equation — Special forms of Riccati's equation — The Lane Emden equation — The nonlinear Pendulum — Duffing equation.

4. LINEAR PROGRAMMING PROBLEM

Simplex algorithm — Two phase and Big M Techniques — Duality theory — Dual simplex method — Integer programming.

5. RANDOM PROCESSES

Classification — Stationary Random Process — Markov Process — Gaussian Process — Markov chain — Auto correlation — cross correlation — response of linear system to random input

REFERENCES

1. Bronson, R., Matrix Operations, Schaum's outline series, McGraw Hill, New York,,1989.
2. Stephenson, 0, Radmore, P.M., Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press 1999.
3. Taha, H.A. Operations, Research, An Introduction, Seventh edition, Pearson Education Edition, New Delhi, 2002.
4. Medhi, J, Stochastic Processes, Wiley Eastern, Ltd., 1994
5. Gupta, A.S., Calculus of variations with applications, Prentice Hall of India Pvt. Ltd. ,New Delhi, 1997

108IEPT02 PROCESS CONTROL

1. PROCESS DYNAMICS

Introduction to process control — Hardware for a Process Control System- modeling considerations for control — Thermal process — Level Process — Flow Process — Pressure Process- Non-Isothermal chemical reactor— Interacting and Non-Interacting Systems-Batch process — Degrees of Freedom — Servo and Regulatory operations — Linearization.

2. CONTROL ACTIONS AND CONTROLLER TUNING

Basic control actions — ON/OFF, P, P+I, P+I+D, floating control — pneumatic and

electronic controllers — design of feedback controllers - synthesis of feedback controller-

controller tuning — time response and frequency response methods —non-linear controller — Anti Reset windup — Bump less transfer — Set point weighting — Auto tuning.

3. COMPLEX CONTROL TECHNIQUES

Feed forward control — ratio control — cascade control — split range control — inferential control — Dead time compensation — adaptive control —IMC — Multivariable Process control - DMC.

4. FINAL CONTROL ELEMENTS

Actuators — Positioners — control valve — valve characteristics — valve bodies — valve sizing — selection factors — valve range ability — cavitation and flashing — Smart valve positioner.

5. UNIT OPERATIONS AND CONTROL

Dynamics and control of mixing process- heat exchanger — evaporator — crystallizer —distillation column.

REFERENCES

1. Harriot P., Process Control, Tata McGraw Hill Publishing Co., New Delhi, 1991
2. Norman A Anderson, Instrumentation, for process measurement and control, CRC Press LLC, Florida, 1998
3. Dale E. Seborg, Thomas F.Edgar, Duncan A. Mellichamp, Process dynamics and control, 2 edition, Wiley John and Sons, 2004
4. Marlin T.E,, Process control, Second edition McGraw Hill, New York, 2000.
5. Balchan J.G. and Mumme G. Process control structures and applications, Van Nostrand Renhold Co., New York, 1988.

108IEPT03 TRANSDUCERS AND SMART INSTRUMENTS

1. SCIENCE OF MEASUREMENT

Units and Standards — Calibration techniques — Classification of errors — error analysis — statistical methods — odds and uncertainty — static and dynamic characteristics of transducers.

2. VARIABLE RESISTANCE AND VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS

Potentiometer — strain gauge — resistance thermometer — hot wire anemometer — LVDT — variable reluctance transducers for measurement of dip and acceleration - Variable capacitive transducers — capacitor microphone.

3. OTHER CONVENTIONAL TRANSDUCERS

Piezoelectric transducer — IC sensors — Piezo-resistive sensors — transducers with frequency output — digital transducers.

4. FIBRE OPTIC TRANSDUCERS

Principles — types and characteristics of fibres — fibre optic transducers for the measurement of force, temperature, flow and pressure.

5. SMART INSTRUMENTS

Smart/intelligent transducer — comparison with conventional transducers — self diagnosis and remote calibration features — smart transmitter with HART communicator —Micro Electro Mechanical Systems — sensors, actuators — principles and applications.

REFERENCES

1. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore,1990.
2. Barney G.C.V., Intelligent Instrumentation: Prentice Hall of India Pvt. Ltd., New Delhi, 1988.
3. Chapman, P. Smart Sensors, ISA publication, 1995.
4. Renganathan, S., Transducer Engineering, Allied Publishers, Chennai, 1999.
5. Handbook of Measuring System Design, Peters H.Sydenham, Richard Thom, John Wiley & sons Ltd., England, 2005.
6. Neubert, Herman, K.P., Instrument transducers: An introduction to their performance and design, 2” edition, Oxford University Press, 1975

108IEPT04 REAL TIME EMBEDDED SYSTEM

1. INTRODUCTION TO EMBEDDED SYSTEMS

Definitions - Brief overview of micro-controllers, microprocessors and DSPs. - Typical classification and application scenarios of embedded systems

2. EMBEDDED SYSTEM COMPONENTS ANS INTERFACE

Embedded processors — Memory Devices — Interface and Peripherals — Power and its Management

3. EMBEDDED SYSTEM DESIGN AND DEVELOPMENT

Design Methods and Techniques — Models and Languages - State Machine and state tables in embedded design - High-level language descriptions of 51W for embedded system, Java based embedded system design - Simulation and Emulation of embedded systems

4. REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS

Event based, process based and graph based models, Petrinet models — Real time languages — The real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services — Real Time languages and their features

5. CASE STUDIES IN REAL TIME EMBEDDED INSTRUMENTS

Specific examples of time-critical and safety-critical embedded systems applications in automotives, aerospace, medicine and manufacturing.-

REFERENCES

1. Ball S.R., Embedded microprocessor Systems — Real World Design, Prentice Hall, 1996.
2. Herma K., Real Time systems — Design for distributed Embedded Applications, Kluwer Academic, 1997.
3. Oassle J., Art ofTrogramming embedded Systems, Academic Press, 1992.
4. Gajski, D.D. Vahid, F., Narayan S., Specification and Design of Embedded Systems, PTR Prentice hall, 1994.
5. Intel manual on 16 bit embedded controllers, Santa Clara, 1991.
6. Slater, M., Microprocessor based design, A Comprehensive guide to effective hardware design, Prentice Hall, New Jersey, 1989.
7. Peatman, J.B., Design with Micro controllers, McGraw Hill International Ltd., Singapore, 1989.
8. C.M. Krishna, Kang C Skin, Real Time Systems, McGraw Hill, 1997.
9. Raymond J.A.Buhr, Donaid L. Balley: An Introduction to Real Time systems, Prentice Hall International, 1999.

108IEPP01 Process Control and Instrumentation Laboratory

(Any 10 Experiments)

1. a) Study of Process Control Training plant

   b) Piping and Instrumentation diagram of a plant

2. Characteristics of control valve (with and without positioner)

3. Study of Compact flow control unit.

4. a) Level and Pressure control in Process control training plant.

   b) Operation of Instructor Desk in Process control training plant.

5. PC based control of Liquid Level System.

6. a) Study of Distributed Control System.

   b) On-Line control using Distributed Control System.

7. Programmable Logic Controller.

8. a) PID Implementation issues

   b) PID Enhancements.

9. a) Design of PID Controller

   b) Auto tuning of PID Controller

10. a) Analysis of Multi-input Multi-output System

    b) Design of Multi-Loop PID Controller and Multixariable PID Controller.

11. Design of Fuzzy Logic Controller

12. Design of Neural Network based Controller

13. Design of Gain scheduling controller

14. Design of Self-Tuning Controller

15. a) Design 3f Deterministic/stochastic State Observer

    b) Design of State Feedback Controller.

16. Design of Robust PID Controller.

208IEPT01 INDUSTRIAL INSTRUMENTATION

1. PRESSURE MEASUREMENT

Pressure standards — Dead weight tester — Different types of manometers — Elastic elements — electrical methods using strain gauge — High pressure measurement — Vacuum gauges — Mcleod gauge — Thermal conductivity gauges — Ionization gauge — differential pressure transmitters — Installation and maintenance of pressure gauges.

2. FLOW MEASUREMENT

Positive displacement flow meters — reciprocating piston type — nutating disc type — oval gear type inferential flow meter — turbine flow meter — variable head flow meters — orifice plate — venturi tube — flow nozzle — dahi tube — rotameter — electromagnetic flow meter — ultrasonic flow meter — Coriolis mass flow meter — calibration of flow meters — installation and maintenance.

3. TEMPERATURE MEASUREMENT

Temperature standards — fixed points — filled system thermometers — bimetallic thermometer — thermocouple — laws of thermocouple — cold junction compensation — measuring circuits — speed of response — linearisation — Resistance thermometer — 3 lead and 4 lead connections — thermistors — IC temperature sensors — Radiation pyrometer — Optical pyrometer — installation, maintenance and calibration of thermometers and thermocouples.

4. LEVEL MEASUREMENT

Visual techniques — float operated devices — displacer devices — pressure gauge method — diaphragm box — air purge system differential pressure method — hydrastep for boiler drum level measurement — Electrical methods — conductive sensors — capacitive sensors — ultrasonic method — point level sensors — solid level measurement — pendant cone.

5. RELIABILITY ENGINEERING

Definition of reliability — reliability and the failure rate — relation between reliability and MTBF — MTTR — maintainabiliiy — availability — series and parallel systems.

REFERENCES

1. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., 1990.

2. Doebelin, E.O. ,Measurement Systems, McGraw Hill Company, 1999.

3. Liptak, E.G., Instrument engineers Handbook, Chilton Book Co., 1994

4. Patranabis, D., Principles of Industrial Instrumentation, Tata McGraw Hill Publishing
Co. Ltd., New Delhi, 1999.

5. Smith, D.J., Reliability Ingineering, Pitman, 1972.

208IEPT02 LOGIC AND COMPUTER CONTROL

1. PLC

Evolution of PLCs — Sequential and programmable controllers — Architecture — Programming of PLC — relay logic — Ladder logic — Functional blocks programming.

2. COMMUNICATION IN PLCS

Requirement of communication networks for PLC — connecting PLC to computer — Use of PC as PLC — comparative study of Industrial PLCs-PLC application in Industrial Automation.

3. ANALYSIS OF DISCRETE DATA SYSTEMS

State space representation of discrete Data systems — Selection of sampling process — Selection of sampling period — Z transform — Data hold pulse transfer function — Modified Z transform — Response of Open loop system and closed loop system – Stability of discrete Data system.

4. DESIGN OF DIGITAL CONTROLLER.

Digital PID Controller — Dead beat Control and Dahlin control algorithms — Pole placement controller — Smith predictof - Design of feed forward controller — IMC'— Multivariable control.

5. **COMPUTER AS A CONTROLLER**

Basic building blocks of computer control system — SCADA- Direct digital control — AI and expert control systems — Case studies on computer control for industrial processes — Introduction to Networked Control system.

REFERENCES

I. Despande,P.B. and Ash, R Computer Process Control, ISA Publication, USA,

2. Houpis C.M., Lamount, G.B., Digital Control Systems — Theory and Hardware and Software International student Edition, Mc-Graw Hill Book Co.,1985.

3. Lucas, M.P., Distributed Control System, Van Nastrand Reinhold Company, New York, 1986.

4. Petrezeulla, Programmable Controllers, Mc-Graw Hill, 1989.

5. Hughes T, Programmable Logc Controllers, ISA Press, 1989.

208IEPT03 COMPUTER NETWORKS AND DCS

1. DATA NETWORK FUNDAMENTALS

Network hierarchy and switching — .open system interconnection model of ISO — Data link control protocol — HDLC— Media Access protocol — Command/response — Token passing - CSMA/CD, TCP/IP.

2. INTERNET WORKING:

Bridges- routers — Gateways — Standard ETHERNET and ARCNET configuration — Special requirements for networks used for control.

3. DISTRIBUTED CONTROL SYSTEMS

Evolution — Different architectures — Local control unit — Operator interface — Display’s — Engineering interface.

4. CASE STUDY

Study of anyone popular DCS available in market — Factors to be considered in selecting DCS —Case studies in DCS.

5. HART AND FIELD BUS .

Introduction — Evolution of signal standard — HART Communication protocol — Communication modes — HART networks — control system interface — HART commands — HART field controller implementation — HART and OSI model — Field bus — Introduction — General field bus architecture — basic requirements of field bus standard — Field bus topology — Interoperability — Interchangeability — Introduction to OLE for process control (OPC).

REFERENCES

1. A.S.Tanenbaum, Computer Networks, Third Edition, Prentice Hall of India, 1996.
2. Michael P.Lucas, Distributed Control System, Van Nastrand Reinhold Company, New York, 1986.
3. Romilly Bowden, HART appUcation Guide, HART Communication Foundation, 1999.
4. G.K.Mc-Millan, Process/Industrial Instrument and controls and handbook, Mc Graw Hill, New York, 1999.

208IEPT04 NEURAL AND FUZZY LOGIC CONTROL SYSTEMS

1. INTRODUCTION TO NEURAL NETWORK

Artificial neuron — Model of Neuron — Network Architecture — Learning Process — Single Layer Perceptron — Limitations — Multi Layer Perceptron — Back propagation algorithm — RBF — RNN — Reinforcement learning - Neural Network Tool Box familiarization — Application of Neural Network in Control

2. NEURAL NETWORKS FOR CONTROL

Schemes of Neuro-control — Identification and cUdtrol of dynamical systems —

Parameterized neuro-controller (PNC) and optimization aspects — Adaptive neuro

controller — Simulation of case studies using Neural Network Tool Box.

3. INTRODUCTION TO FUZZY LOGIC

Fuzzy set theory — Fuzzy sets — Operation on Fuzzy sets — Fuzzy relations — Fuzzy membership functions — Fuzzy conditional statements — Fuzzy rules.

4. FUZZY LOGIC CONTROL SYSTEM

Fuzzy Logic controller — Fuzzification — Knowledge base — Decision making logic — Defüzzification — Design of Fuzzy logic controller — Adaptive fuzzy systems — Simulation of case studies using Fuzzy Logic Tool Box.

5. HYBRID CONTROL SCHEMES

Fuzzy Neuron — Fuzzification and rule base Using ANN — Introduction to GA — Optimization of membership function and rule base using Genetic Algorithm — Case study.

REFERENCES

1. ILaurence 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. Tsoukalas L.H., and Robert E.Uhrig, Fuzzy and Neural approach in Engineering, John Wiley and Sons, 1997.
5. Jacek M.Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, Mumbai, 1997.
6. Millon W.T., Sutton R.S., and Webrose P.J., Neural Networks for control, MIT Press, 1992.
7. MATLAB Neural Network Tool Box Manual.
8. MATLAB Fuzzy Logic Tool Box Manual.

208IEPP01 MODELLING AND SIMULATION LABORATORY

(Any 10 Experiments)

1. Simulation of Lumped Parameter System.
2. Simulation of Distributed Parameter System.
3. Identification of Linear dynamic model (Black-Box) of a process using non-parametric methods.
4. Identification of Linear dynamic model (Black-Box) of a process using parametric methods.
5. Identification of Grey-Box model of a process.
6. Identification of certain class of non-linear models using parametric methods.
7. Constrained non-linear least squares optimization.
8. Determination of Linear deterministic! stochastic state space model of a non linear process described using non-linear differential equations.
9. Response of different processes for with and without PID Controller.
10. Statistics and Optimization tool box.
11. Virtual Instrumentation Package.
12. SCADA Package

108IEPE04 POWER PLANT INSTRUMENTATION

1. AN OVERVIEW OF POWER GENERATION

Brief survey of methods of power generation — hydro, thermal, nuclear, solar and wind power — An outline of boilers — Feed water ystems — steam circuits — Combustion process — Products of combustion process — Fuel systems — Treatment of flue gases — steam turbine — condensate systems — Alternators — feed water conditioning

2. MEASUREMENT IN BOILER AND TURBINE

Metal temperature measurement in boilers — Application of temperature measuring system on power plant, piping system for pressure measuring devices, smoke and dust monitoring, flame monitoring — Turbine supervising system; Pedestal vibration, shaft vibration, eccentricity vibration. Installation of non-contact transducers for speed measurement, rotor and casing movement, Expansion measurement.

3. CONTROL LOOPS AND INTERLOCKS IN BOILER

Combustion control — Control of main header pressure, air/fuel ratio control -furnace draft and excessive air control, drum level three element control and reheat steam temperature control, burner tilting up, bypass dump super heater control — spray and gas re-circulation control — B.F.P. recirculation control — hot well and deaerator level control — Pulverizer control.

4. ANALYZERS IN POWER PLANT

Thermal conductivity type — Paramagnetic type oxygen analyzer — infrared type and trim. analyzer — Spectrum analyzer — hydrogen purity meter — chromatography - pH meter-conductive cell - fuel analyzer — brief survey of pollution monitoring and control equipment.

5. NUCLEAR POWER PLANT INSTRUMENTATION

Piping and Instrumentation diagram of different types of nuclear power plant — Radiation detection Instruments, Process sensors for nuclear power plant, Nuclear reactor control system and allied Instrumentation.

REFERENCES

I. British Electricity International, Modem Power station practice, Vol.6, Pergamon press, 1992.

2. David Lindsicy, Boiler control systems, McGraw Hill Book Company, 1997.

3. Jervis M.J., Power station Instrumentation, Butterwdrth Heinemann, 1993.

4. Elanka. S.M and Kohal A.L, Standard boiler operations, McGraw Hill, NewDelhi 1994.

308IEPE03 INSTRUMENTATION IN PULP AND PAPER INDUSTRY

1. AN OVERVIEW OF PAPER MAKING PROCESS

Paper making process — Raw materials — Pulp separation — screening — Bleaching — Cooking — Chemical reaction — chippers — types of digesters — H factor and Kappa factors- Stock preparation — Instrumentation needs — Energy conservation and paper quality control.

2. PAPER PROPERTIES AND ITS MEASUREMENT

Physical, electrical, optical and chemical properties of paper — Basic weight, thickness, density, porosity, smoothness, softness, hardness and compressibility — stress-strain relationship — Tensile strength, bursting strength, tearing resistance, folding endurance, stifihess and impact strength — Dielectric constant, dielectric strength, dielectric loss and Properties of electrical insulating paper — Brightness, colour, gloss and capacity — Starch constant acidity and pH - Measurement techniques.

3. CONSISTENCY MEASUREMENT

Definition of consistency — Techniques for head box consistency measurement — Stock consistency measurement and control.

4. PAPER MAKING MACHINE

Functioning of Paper making machine — Quality parameters — moisture, basic weight, caliper, brightness, colour, ash content, strength, gloss and tensile strength - parameters monitoring Instrumentation.

5. CONTROL ASPECTS

Machine and cross direction control technique — consistency, moisture and basic weight control — dryer control — computer based control systems - mill wide control.

REFERENCES

1. Sankaranarayanan, P.E., Pulp and Paper Industries — Technology and Instrumentation Kotharis Desk book series, 1995.
2. Handbook of Pulp and Paper technology, Britt K.W.Van Nostrand Reinbold Company, 1970.
3. James P.Casey , Pulp and Paper chemistry and chemical Technology, John Wiley and sons, 1981.
4. Austin G.T., Shrencs Chemical Process Industries, McGraw Hill International Student Edition, Singapore, 1985.

108IEPE02 FIBER OPTIC AND LASER INSTRUMENTATION

1. OPTICAL FIBERS AND THEIR PROPERTIES

Principles of light propagation through a fiber - Different types of fibers and their properties — Fibre materials and their characteristics - Transmission characteristics of fibers - absorption losses - scattering losses — Dispersion - Measurement on optical fibers - Optical sources - Optical detectors.

2. FIBER OPTIC SENSORS IN MEASUREMENT.

Fiber optic instrumentation system - Fiber optic sensors Different types of modulators - Application in instrumentation - Interferometric method of measurement of length - Measurement of pressure, temperature, current, voltage, liquid level and strain.

3. FUNDAMENTALS OF LASER INSTRUMENTS

Fundamental characteristics of laser - three level and four level lasers - properties of lasers - laser modes - resonator configuration - Q-switching and mode locking - cavity dumping - types of laser - gas laser, solid laser, liquid laser - semi conductor laser.

4. LASERS IN MEASUREMENTS AND TESTING

Laser for measurement of distance, length, velocity, acceleration, current, voltage, and atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization. Holography - Basic principle; methods; Holographic interferometry and applications; Holography for non-destructive testing - Holographic components

5. MEDICAL APPLICATIONS OF LASERS 6

Medical applications of lasers; laser and tissue interaction - Laser instruments for surgery.

REFERENCES

I. John and Harry, Industrial lasers and their applications, McGraw Hill, 1974.

2. John F Ready, Industrial applications of lasers. Academic press, 1978.

3. John Crisp, Introduction to Fibre Optics, an imprint of Elsevier Science, 1996.

4. Jasprit Singh, Semi conductor Optoelectronics, McGraw Hill, 1995.

5. Silvano Donati, Electro-optical Instrumentation Sensing and Measurement with Laser, Prentice Hall, 2004..

208IEPE03 BIO-MEDICAL INSTRUMENTATION

1. INTRODUCTION TO PHYSIOLOGICAL SYSTEM

Bio potential - Resting and action potential — Electrodes - different type of electrodes — Equivalent circuits for electrodes — Electrical safety — Bioamplifiers — Characteristics and requirements -

2. ELECTRO- PHYSIOLOGICAL MEASUREMENT

Electro Cardiograph (ECO), Electro Encephalograph (EEG), Electromyograph (EMG), Phono cardiograph (PCG), Electroretinogram (ERG) — Electro Occulograph (EGG).

3. BIO-MEDICAL MONITORING SYSTEMS

Blood pressure measurement — Direct and Indirect methods -measurement of Heart rate - Heart sound - Measurement of blood flow - Cardiac output — Measurement of respiration and Gas Flow.

4. ASSISTING AND THERAPUTIC DEVICES

Cardiac pacemakers — Defibrillators - Heart lung machine — Muscle Simulator — Electrotheraphy - Diathermy - Introduction to artificial organs.

5. IMAGING IN BIOMEDICAL ENGINEERING 9

X-ray machine — Computed Axial Tomography — MRI — Ultra sound Imaging — Endos copy.

REFERENCES

1. Cromwell U, Biomedical instrumentation and measurements, Prentice Hall of India, 1995.
2. Khandpur.R.S, I-land book of biomedical instrunientation, Tata McGraw Hill, 1996.
3. Cohen A, Bio-medica signal processing Vol.1, CRC Press. Inc., Florida 1988.
4. Jacabson B, Webstar J.G., Medicine and clinical engineering, Prentice Hall of India, 1979.
5. Wise D.L., Applied bio-sensors, Butterworth, U.S.A., 1989.
6. Geddes and Baker, Principle of applied bio-medical instrumentation, John Wiley and sons, 1975.
7. T.R.angaraj, M.Rangayyar, Biomedical Signal Analysis, John Wiley & sons (ASIA) Pvt. Ltd., 2002.

108IEPE05 **SYSTEMS THEORY**

1. FREQUENCY DOMAIN DESCRIPTIONS

Properties of transfer functions—Impulse response matrices — poles and zeros of transfer function matrices — critical frequencies — resonance — steady state and dynamic response bandwidth — singular value analysis — multivariable Nyquist plots.

2. STATE SPACE DESCRIPTION

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. DESIGN IN STATE SPACE SYSTEMS

State Feedback — Output Feedback — state feed-back control- pole placement technique — Full order and Reduced Order Observers — Deadbeat Observers- Dead beat Control

4. NON-LINEAR SYSTEMS

Types of Non-Linearity — Typical Examples — Phase plane analysis (analytical and

graphical methods) — Limit cycles — Equivalent Linearisation — Describing Function

Analysis. Derivation of Describing Functions for different non-linear elements.

5. STABILITY OF NON-LINEAR SYSTEMS

Stability concepts — Equilibrium points — BIBO and Asymptotic stability — Stability

Analysis by DF method — Liapunov Stability Criteria — Krasovskii's method — Variable Gradient Method — Popov's Stability Criterion. -

REFERENCES

1. M.Gopal, "Modern Control System Theory", Wiley Eastern Limited, 2 edition, 1996.
2. Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado PHI, 2002.
3. K.Ogata, "Modern Control Engineering", PHI, 3"' edition, 1997.
4. M.Gopal, "Control System Principles and Design", 2" Edition, 2002.
5. I.J.Nagrathl M.Gopal, "Control Systems Engineering", New Age International (P) Ltd., 2 edition, 1989.
6. WL.Luyben, "Process Modelling, simulation and control for Chemical Engineers", 2' edition, McGraw Hill, 1990.
7. D.P.Atherton, "Stability of non linear systems", Prentice Hall, 1986.

208IEPE01 ANALYTICAL INSTRUMENTATION

1. SPECTRO PHOTOMETRERS

Spectral methods of analysis —UV, Visible, IR, FTIR, atomic absorption - Flame emission mass spectrophotomcters — Sources-detectors — Application.

2. ION CONDUCTIVITY AND DISSOLVED COMPONENT ANALYSER

Sampling systems — Ion selective electrodes — Conductivity meters — p1 meters — Dissolved oxygen analyzer — Sodium analyzer — Silica analyzer — Turbidity meter — Case study — Industrial Applications.

3. GAS ANALYSER

Oxygen analyser — Co_2 and CO monitor — NO_2 analyser — H_2 analyser — Dust and Smoke measurement — Thermal conductivity type — Thermal analyser — Industrial analyser.

4. CHROMATOGRAPHY .

Gas chromatography — Liquid óhromatography — Principles- Types and Applications — HPLC— Detectors.

5. NMR, X-RAY AND MASS SPECTROMETRIC TECHNIQUES

NMR Spectroscopy — Principle and Detection —GM counter — Proportional counters — X-ray spectroscopy— Mass spectrometer - Applications.

REFERENCES

I. Willard H.H, Merit L.L, Dean J.A Seattle F.L., Instrumental methods of Analysis, CBS Publishing and distribution, 1995

2. Skoog, D.A. and West D.M., Principles of Instrumental Analysis, Holt Sounder Publication, Philadelphia, 1985.

3. Robert D. Braun, Introduction to Instrumental Analysis, McGraw — Hill, Singapore, 1987.

4. Ewing G.W, Instrumental Methods of Analysis, McGraw- Hill, 1992.

5. Mann C.K, Vickers T.J and Guilliclc W.H, Instrumental Analysis, Harper and Row Publishers, New York, 1 974.

6. Liptak B.G, Process Measurement and analysis, Chilton Book Company, 1995.

7. Frank A.Settle, Handbook jf. Instrumental Techniques for Analytical Chemistry, Prentice Hall, New Jersey, 1927.

208IEPE02 OPTIMAL CONTROL

1. INTRODUCTION

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

2. DYNAMIC PROGRAMMING

The principle of optimality, An optimal Control system, The recurrence relation of Dynamic programming, Computational procedure, The H-S-B equation and analytical results for discrete and continuous linear regulator problems.

3. THE CALCULUS OF VARIATIONS

Fundamental concepts, Functionals of a single function and function involving seven! independent functions, Piecewise-smooth extremals, Constrained extrema, Necessary condition for optimal control, Linear regulator problems.

4. THE MINIMUM (MAXIMUM) PRINCIPLE

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, Numerical techniques.

5. CASE STUDIES

Optimal control in selected applications — distillation column, boiler, paper manufacturing plant with simulation packages.

REFERENCES

1. Donald Kirk, Optimal Control Theory, Prentice Hall.
2. B.D.O.Anderson and J.B.Moore, Optimal Control: Linear Quadratic Methods, Prentice Hall, 1990.
3. T.Basar and G.J.Olsder, Dynamic Noncoperative Game Theory, SIAM classics in Applied Mathematics, 1999.
4. Andrew P.Sage and Chelsea C.White, Optimum Systems Control, 2" edition, Prentice Hall, 1977.
5. D.P.Bertsekas, Dynamic Programming 'rnd Optimal Control, Vol.!, 2 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, edition, Blaisdel, 1975.
8. L.B.Lee and L.Markus, Foundations of Optimal Control Theory, Wiley, 1967.

108IEPE01 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

1. NONPARAMETRIC METHODS

Nonparametric methods: Transient analysis — frequency analysis — Correlation analysis — spectral analysis

2. PARAMETRIC METHODS

Linear Regression: The Least Square estimate — best linear unbiased estimation under linear constraints —updating the parameter estimates for linear regression models - Prediction Error Methods: description of prediction error methods — Optimal prediction — relationships between prediction error methods and other identification methods — theoretical analysis.

Instrumental Variable Methods: Description of instrumental variable methods — theoretical analysis — covariance matrix of IV estimates — comparison of optimal IV and prediction error estimates.

3. RECURSIVE IDENTIFICATION METHODS

The recursive least squares method — the recursive instrumental variable method — the recursive prediction error method — Model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations — direct identification — indirect identification —joint input — output identification.

4. ADAPTIVE CONTROL SCHEMES

Introduction — Uses — Definitions — Auto tuning — Types of adaptive control — gain scheduling controller — model reference adaptive control schemes — self-tuning controller

MRAC and STC:

Approaches — The Gradient approach — Liapunov functions — Passivity theory — pole placement method — Minimum variance control — Predictive control.

4. ISSUES IN ADAPTIVE CONTROL AND APPLICATIONS

Stability – Convergence – Robustness- Application of adaptive control.

REFERENCES

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

2. Soderstorm, T. and Petre Stoica, System Identification, Prentice Hall International (UK) Ltd, 1989.

3. Sastry S. and Bodson M., Adaptive control — stability, Convergence and Robustness, Prentice Hall inc New Jersey, 1989.

108IEPE03 JAVA AND VISUAL PROGRAMMING

1. INTRODUCTION TO PROGRAMMING

Procedural programming - Structured programming - Object oriented programming — Windows programming fundamentals.

2. VISUAL C++ ENVIRONMENT

Graphics Device Interface (GDI) — GDI primitives-Device contests and graphics object-Defining windows structure — Registering — Display,— Message handling methods — Programming with Windows controls — Resources.

3. MFC PROGRAMMING

Document / View architecture — SDI and MDI, MFC Programming with Windows controls and resources — App Wizard and Class Wizards.

4. JAVA PROGRAMMING

Java environment - classes -definition - Fields - Methods -Object creation — Constructors - Overloading methods - Static members - This key work - Nested classes. Extending classes - Inheritance - Member accessibility - Overriding methods — Abstract classes - Interfaces - Exception handling - File I /O - Java tools.

5. JAVA APPLETS AND NETWORKING

Visual J++ Applet hazard - Handling events - Multi threading - Animation techniques — Animating images - Applets and HTML - Java beans - Java script - Consimig scripts

and applets - Applets overweb and networking.

REFERENCES

1. Marion cottingham, Visual Basic, Peachpit press, 1999.
2. Kate Gregory, Using visual C++, Prentice Hall of India Pvt. Ltd., 1999.
3. H.M.Deitel and P.J.Deitel, Java how to program with an introduction to visual J++, Prentice Hall, 1998.
4. Jason Bloomberg, Jelf Kawshi and Paul Treffers, Web page scripting techniques, Hayden books, 1996.

108IEPE06 DIGITAL SIGNAL PROCESSING

1. DISCRETE TIME SIGNALS AND SYSTEMS

Sampling of Analog signals-Aliasing, Standard discrete time signals- Classification of discrete time systems- Linear time invariant systems, causality, stability- Convolution sum- Difference equation representation Review of Z Transform

2. DISCRETE FOURIER TRANSFORM

Discrete Fourier Series- Sampling of Z Transform- Fourier Representation & Finite duration Sequence- Properties of DFT- Relation between Linear and Circular Convolution- Overlap add and Overlap Save methods- Radix 2 Fast Fourier Transform-Mixed Radix.

3. IIR AND FIR FILTER DESIGN

Classification — Realizability Constraints- Hardware realization (Structures) — Design- Impulse Invariant method- Bilinear Transformation method- FIR Design-Fourier Series Method- Window Function method - Study of TMS and ADSP processors.

4. MULTIRATE DIGITAL SIGNAL PROCESSING

Interpolation and Decimation - 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

5. ADAPTIVE FILTERS

Introduction to adaptive filters — FIR adaptive filters — Widrow Hoff LMS adaptive algorithm — Adaptive echo canceller — Adaptive noise cancellation — RLS adaptive filter — LMS adaptive filter.

REFERENCES

1. John.G.Proakis, Dimetris G.Manolakis, "Digital Signal Processing", Prentice Hall of India, 1995.
2. Openheim A.V., and Schafer R.W., Discrete Time Signal Processing, Prentice Hall, NJ, 1980.
3. "Digital Signal Processing & computer based approach", Sanjit K.Mitra, Tata McGraw Hill Publications, 2004.
4. "Digital Signal Processors Architecture, Programming and Applications", B.Venkataramani, M.Bhpskar, Tata McGraw Hill Publications, 2003.
5. Widrew, B., and Steans.. S.D., "Adaptive Signal Processing", Prentice Hall, 1985

308IEPE01 ROBUST CONTROL

UNIT I

Introduction — measure of robustness — plant uncertainty model — robustness of sampled — data control system.

UNITII

Analysis of robustness — stability analysis — gamma stability — testing sets — Kharitonon's theorem — stability radius.

UNIT III

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

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

UNIT V

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

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 Hco methods, Springer, London, 2000.
4. R.C.Dorf and R.H.Bishop, Modem Control Systems, Addison-Wesley, Delhi,

   1999.

308IEPE02 VIRTUAL INSTRUMENTATION

1. INTRODUCTION

Virtual Instrumentation — Definition, flexibility — Block diagram and Architecture of Virtual Instruments — Virtual Instruments versus Traditional Instruments — Review of Popular software in virtual Instrumentation — VI programming techniques - VI, sub VI, Loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, string and file Input/output.

2. DATA ACQUISITION IN VI

A/D, D/A converters, plug-in Analog input/output cards - Digital Input/Output cards, Organisation of the DAQ VI system - Opto isolation - Performing analog input and analog output - Scanning multiple analog channels - Issues involved in selection of data acquisition cards - Data acquisition modules with serial communication - Design of digital voltmeters with transducer input — Timers and counters.

3. COMMUNICATION NETWORKED MODULES

Introduction to PC Busses — Local busses: ISA — PCI — RS232 — RS422 — RS485 — Interface Busses — USB, PCMCIA, VXI ,SCXI , PXI. - Instrumentation Busses : Modbus — GPIB - Networked busses — ISO/OSI Reference model, Ethernet — TCP/IP protocols.

4. REAL TIME CONTROL IN VI

Design of ON/OFF controller, PID controller and Fuzzy controller for a mathematically described process using VI software - Level and Reactor control using VI — Case studies on development of HMI, SCADA in VI.

5. APPLICATIONS

PC based digital storage oscilloscope, Sensor technology and signal processing, VI laboratory, spectrum analyser, waveform generator — Data visualization from multiple locations; Distributed monitoring and control devices, vision and motion control.

REFERENCE

1. Rahman Jamal and Herbert Picklik, Labview — Applications and solutions National Instruments Release ISBN 0130964239.
2. Gary Jhonson, Labview Graphical programming, Mc Graw Hill, Newyork, 1997.
3. Lisa K. Wells and Jeffrey Travis, Labview for everyone, Prentice Hall, NewJersey, 1997.
4. S. Gupta and J.P. Gupta, 'PC interfacing for data acquisition and process control', second edition, Instrument Society of America, 1994.

208IEPE04 MULTIVARIABLE CONTROL

UNIT-I

Linear System Review: controllability and Observability; transfer functions and their realizations; cascade, parallel, and feedback systems. Lyapunov Stability Theory: Lyapunov stable, semi-stable, asymptotically stable systems.

UNIT-Il

The Standard Problem: Two-input, two-output (TITO) formulation; Gramians and Lyapunov equations; dual and modem forms; poles. The H2 Norm: Frobeneus norm; free, forced, impulse response; integral squared response; frequency domain and Parseval

UNIT-Ill

Linear Quadratic Regulator (LQR) Synthesis: Hamilton-Jacobi equations; two-input, two-output (TITO) representation; weighting matrices; closed loop properties; Lagrange multipliers; state and control costs.

UNIT- IV

Analysis of the Riccati Equation: compare to Lyapunov eqn; the Hamiltonian matrix; stabilizing solutions; frequency domain properties of LQR; the Nyquist test; gain and phase margins.

UNIT-V 9

Passivity, Positivity, Self-Dual realizations, and collocation. Linear Quadratic Gaussian (LQG) Controller Synthesis: closed loop properties, H2 performance, observers and the Kalman filter, frequency domain performance specifications, reduced order LQG. H1 Analysis and Synthesis: H1 norm for SISO and MIMO cases; nominal performance, robust stability, mixed sensitivity; H2 / H1 with cross-weighting; loop-shaping.

REFERENCES

1. B.D.O. Anderson and J.B. Moore, Optimal Control: Linear Quadratic Methods, Prentice-Hall, 1990.
2. J. Doyle, B.A. Francis, and A. Tannenbaum, Feedback Control Theory, Prentice Hall, 1990.
3. T. Glad and L. Ljung, Control Theory: Multivariable & Nonlinear Methods, Taylor & Francis, 2000.
4. T. Kailath, Linear Systems, Prentice-Hall, 1991.
5. Donald E. Kirk Optimal Control Theory: An Introduction, Prentice Hall, 1970.
6. S.P. Sage and C.C. White III, Optimum System Control, 2nd ed. Prentice-Hall, 1977.
7. S. Skosgestad and I. Postlethwaite, Multivariable Feedback Control: Analysis and Design, John Wiley & Sons, 1996.
8. R. Stengel, Optimal Control and Estimation, Dover Press, 1994.

308IEPE04 PHYSIOLOGICAL CONTROL SYSTEMS

1. INTRODUCTION TO PHYSIOLOGY AND PHYSIOLOGICAL CONTROL SYSTEMS

Introduction to Human Physiology - Analysis of Physiological Control Systems - Difference between engineering and physiological control systems.

2. STATIC ANALYSIS OF PHYSIOLOGICAL SYSTEMS

Open loop and Closed loop systems- Steady state analysis- Regulation of Cardiac Output- Regulation of Glucose- Chemical regulation of ventilation.

3. TIME FREQUENCY DOMAIN ANALYSIS OF LINEAR PHYSIOLOGICAL CONTROL SYSTEMS

Linearized respiratory mechanics- Open loop and Closed loop transient responses- First order and second order models- Impulse and Step response descriptors- Open and closed loop dynamics- Steady state responses to sinusoidal inputs- Graphical representations of frequency response- Frequency response of Glucose- Insulin regulation and Circulatory Control Model.

4. NON-LINEAR ANALYSIS OF PHYSIOLOGICAL CONTROL SYSTEMS 9

Difference between linear and non-linear systems- The Hodgkin-Huxley model and The Bonhoeffer- van der Pol model of Neuronal dynamics - Spontaneous Variability- Delayed feedback Nonlinear Control systems- Coupled non-linear Oscillators- Time varying Physiological closed loop systems- Sleep Apnea model.

5. CASE STUDIES AND SIMULATION

Simulation of cardiovascular variability (stroke volume constant and stroke volume variable)- Simulation of glucose- insulin regulation (Stolwijk and Hardy model) Simulation of neuromuscular reflex model -Simulation of patient- ventilator system- Simulation of respiratory sinus arrhythmia (Saul model).

REFERENCES

I. Michael. C. K. Khoo, Physiological Control Systems, IEEE Press, Ed., Robert. S. Herrick, Prentice — Hall of India, New Delhi, 2001.

2. Milhorn, H. T., The Application of Control theory to Physiological Systems, Saunders, W. B., Philadelphia, 1996.

3. Kuo, B. C., Automatic Control Systems, 4 ed., Prentice- Hall, Englewood Cliffs, NJ, 1994.

4. Dorf, R. C. and Bishop, R. H., Modern Control Systems, 7 ed., Addison- Wesley Reading, MA, 1995. .

5. Thompson, J. M. T. and &Stewart, H. B., Nonlinear dynamics and chaos, Wiley, New York, 1986.

308IEPE05 INDUSTRIAL DRIVES AND CONTROL

I. INTRODUCTION TO AC AND DC DRIVES

Braking of series and separately excited DC motor. Inching and jogging, Models and transfer function of series and separately excited DC motor. Torque, slip characteristics, Operation with different types of toads, performance, comparison of different ac power controllers, Speed reversal, closed loop control with respect to ac motor

2. CONTROL OF DC DRIVES

Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations, Problems on DC machines fed by converter supplies CLC and TRC strategies. Analysis of series and separately excited DC motors fed from different Choppers, effect of saturation in series motors - CLC and TRC strategies.

3. CONTROL OF AC DRIVES

Operation of induction motor with non-sinusoidal supply waveforms, Variable frequency operation of 3-phase induction motors, Constant flux operation, Current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives. Types of rotor choppers, Torque Equations, Constant torque operations, TRC Strategy, Combined stator voltage control and rotor resistance control Principle of vector control — Direct and Indirect FOC.

4. SPECIAL MACHINES

Modeling and control schemes for Universal Motor, PMSM, PMBLDC and switched reluctance motor

5. CASE STUDY

Investigation on intelligent control strategies for permanent magnet, brushless dc Drive

REFERENCES

1. Ruxbaum, A.Schierau, K.and Staughen, "A Design of control System for d.c. Drives ", Springer-Verlag, berlin, 1990
2. Dubey, O.K. "Power Semiconductor Controlled Drives ", Prentice Hall International, New Jersey, 1989.
3. Murphy, J.M.D, Turnbull, F.G. "Thyristor control of AC motors ", Pergamon Press, Oxford, 1988.
4. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives ", Ciarendon Press, Oxford, 1989.
5. Subharamanyam V. "Electric Drives -Concepts and Applications ", Tata McGraw Hill Publishing Co., Ltd New Delhi, 1994.
6. B.K. Bose, Expert system, fuzzy logic and neural network applications in power electronics and motion control, Proceedings of IEEE, Special issue on Power electronics and motion control, August 1994, PP.1303.

308IEPE06 DATA SECURITY AND CRYPTOGRAPHY

1. NUMBER THEORY:
Divisibility: primes, factorization, solving ax + by = d — Euclidean algorithm — Congruences: Fermat's little theorem, Chinese remainder theorem — Modular arithmetic — Quadratic residues — Finite fields — Discrete logarithm.

2. CLASSICAL CRYPTOSYSTEMS:
Symmetric cipher model — Substitution ciphers: shift pipher, mono-alphabetic cipher, playfair cipher, Hill cipher, affine cipher, polyalphabetic cipher, one time pad — Transposition cipher — Steganography — Stream cipher — Block cipher: Data Encryption Standard, Modes of operations, Advanced Encryption Standard.

3. PUBLIC KEY CRYPTOSYSTEMS:
Principles of Public-Key cryptosystem — Key management — RSA algorithm — Diffie - Hallman key exchange — El Gamma! cryptosystems — Elliptic curve cryptography — Attacks on cryptosystems.

4. AUTHENTICATION PROTOCOLS:
Authentication requirements — Message authentication code — Hash functions — Digital signature: RSA signature, El Gammal signature — Authentication protocols — Digital Signature Standard — Password-based authentication — Attacks on authentication protocols — Zero knowledge proofs.

5. OTHER SYSTEMS: **7**
Chaos based cryptography — Knapsack algorithm — Quantum computing / cryptography — DNA based cryptography.

REFERENCES:

1. Neal Koblitz, A Course in Number Theory and Cryptography, Springer, Second Edition, 2000
2. William Stallings, Cryptography and Network Security: Principles and Practices, Pearson Education, Third Edition, 2004
3. Wade Trappe, Lawrence C. Washington, Introduction to Cryptography with Coding Theory, Prentice Hall, 2002
4. Wenbo Mao, Modern Cryptograph: Theory and Practice, Pearson Education, 2004
5. Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, Handbook of Applied Cryptography, CRC press, 1997
6. Douglas R. Stinson, Cryptography: Theory and Practice, CRC press, 1995
7. B. Schneier, Applied Cryptography: Protocols, Algorithms and Source Code in C, John Wiley and Sons, Second Edition, 1996
8. Charles P. Pfleeger, Shari Lawrence Pfleeger, Security in Computing, Pearson Eduction, Third Edition, 2004
9. Lecture Notes in Computer Science, Vol.2950, Aspects of Molecular Computing, Springer-Verlag, 2004

3**08IEPE07** **VLSI SYSTEM DESIGN**

1. BASIC DEVICE CHARACTERISTICS

NMOS, PMOS and CMOS devices characteristics, linear, saturation modes, bulk effect capacitances, device models for simulation, CMOS device fabrication principles

2. BASIC CIRCUITS FOR DIGITAL SYSTEMS

CMOS Inverter Design principles — Design layout rules. Construction of multiplexers, transmission gates, latches, flip flops. Timing and fan-out considerations.

3. BUILDING BLOCKS OF DIGITAL SYSTEMS

Combinational logic and sequential logic circuits, Data path circuits, Adder multiplier architecture and accumulators.

4. PROGRAMMABLE LOGIC DEVICES AND FPGAs

Programmable Logic interconnect principles and types, Programmable logic elements and AND-OR arrays, Routing Procedures in FPGAs and CPLDs, Programming methods for FPGAs and CPLDs, Comparison of ACTEL, Altera and Xlinx FPGAS.

5. PRINCIPLES OF HDL

1Introduction to VHDL-Sequential and concurrent descriptions. Signal, Port and variable statements. Wait, case and other sequential statements. Block, process, component and generate descriptions. Test bench creation and principles of operation of VHDL simulator. Introduction to verilog and brief comparison with VHDL.

REFERENCES **-**

1. Smith, M Application specific Integrated Circuits Addision Wesley Press, 1999.
2. Rabey, J.M., Digital Integrated Circuits: A design Perspective, Prentice Hall, 1995.
3. Weste, N.H.E and Ershingian, K., Principles of CMOS VLSI Design: A Design Perspective, Addison Wesley, 1996.
4. Bhasker,J., VHDL Primer, Prentice Hall 1995.

208IEPE05 OPERATING SYSTEMS

1. OPERATING SYSTEMS OVERVIEW

Multiprogramming - Time sharing- Multi-operating systems Structure of operating systems.

2. PROCESS MANAGEMENT

Concept of processes - Interprocess communication - Racing - Synchronisation — Mutual exclusion - scheduling - Implementation issues - IPC in Multiprocessor system - Case study - UNIX - Windows NT.

3. MEMORY MANAGEMENT:

Partition - Paging - Segmentation - Virtual memory concepts - Relocation algorithms — Buddy systems free space management - Case study - DOS and UNIX - WINDOWS.

4. DEVICE MANAGEMENT:

I/O Controller - Device handler - Driver handler - Scheduling - Concurrency — Deadlock and Starvation, various 110 devices - File system design — Directory Management - Case studies DOS - UNIX.

5. MODERN OPERATING SYSTEMS:

Concepts of distributed Operating systems - Real time operating systems.

REFERENCES

1. Tanenbaum, A.S.., Operating system - Design and Implementation , Prentice Hall, 1992.
2. Peterson,J.L., & P.B.Galvin, Operating system concepts third edition, Addison Wesley 1991.
3. Stallings, W. Operating systems, Second edition, Prentice Hall, 1995.
4. Milanleovic,N., Operating systems, McGraw Hill, 1987.
5. Tanenbaum, A., Modem operating systems, Prentice Hall, 1995.

208IEPE06 ADVANCED DIGITAL SIGNAL PROCESSING

1. DISCRETE RANDOM SIGNAL PROCESSING

Weiner Khitchine relation - Power spectral density — filtering random process, Spectral Factorization Theorem, special types of random process — Signal modelling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

2. SPECTRUM ESTIMATION

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators — Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

3. LINEAR ESTIMATION AND PREDICTION

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

4. ADAPTIVE FILTERS

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

5. MULTIRATE DIGITAL SIGNAL PROCESSING

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

REFERENCES:

I. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 1996.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 1990.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 1
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ
5. S. Kay," Modem spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs, NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

308IEPE08 WIRELESS NETWORKS

1. WIRELESS LAN

Infrastructure and adhoc networks, IEEE 802.11, 802.16-system architecture — protocols — physical layer-MAC layer-management —future development, l-IJPERLAN-protocol architecture, physical layer, channel access control sub layer, medium access control sub layer. Bluetooth — physical layer MAC layer, networking, security, link management.

2. WIRELESS ATM

Motivation, services, reference model, functions , radio access layer, handover, location management ,addressing, quality of service, access point control protocol.

3. WIRELESS MAC PROTOCOLS

Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, MCDMA Comparison.

4. MOBILE NETWORK LAYER

Mobile IP- requirement, terminology, packet delivery, agent advertisement, registration, tunnelling and encapsulation, optimization, reverse tunnelling, lPv6. Dynamic host configuration protocol. Ad hoc networks — routing, destination sequence distance vector, dynamic source routing, hierarchical algorithm, alternative metrics, power optimization in routing protocols for wireless and mobile networks.

5. MOBILE TRANSPORT LAYER AND MOBILITY

Traditional TCP, Indirect TCP, Snooping TCP, mobile TCP, Fast retransmit/Fast recovery, transmission/ time-out freezing. Selective retransmission, wireless security issues, transaction oriented TCP, File systems, WWW, Wireless application protocols.

REFERENCES:

1. Jochen Schiller "Mobile Communication"-Pearson education, 2002.
2. C.K. Toh "Ad hoc mobile wireless networks, protocols and systems"- prentice Hall PTR, 2003.
3. Chales E Perkins "Ad hoc networking"- Addition Wesely professional.
4. Kavenpahalavan and prashant krishnamurthy, "Principles of Wireless Networks", PHI, 2004.
5. Benny Bing, "Wireless Local Area Networks", John Wiley 2002.
6. William Stallings, "Wireless Communication and Networking", Pearson education, 2002.
7. Stallings, "Network Security essential. Application & Standards", Pearson education, 2004.
8. Uwe Hansmann, Lothar Meck, Martin.S Nicklons & Thomas Stober, "Principles of mobile computing", Springer Newyork 2003.

108IEPE07 IMAGE PROCESSING & PATTERN RECOGNITION

UNIT 1 : IMAGE REPRESENTATION

Sampling, quantization, Image Basis Function, Two dimensional DFT, Discrete cosine Transform, Walsh- Hadamard transform, wavelet transform, principal component analysis.

UNIT 2: IMAGE ENHANCEMENT AND RESTORATION

Edge Detection, Thresholding, Half toning, Median filtering, Histogram Equalization, Homomorphic filtering, PSFs for Different forms of Blur- Defocused lens with circular aperture- Uniform Motion Blur, Long-Exposure atmospheric Blur.

3. IMAGE COMPRESSION

Transform coding, Predictive compression methods, Vector quantization, Hierarchical and Progressive compression methods, JPEG, Video coding, Motion Estimation, MPEG Lossless compression, Huffman coding, run length coding and Arithmetic coding.

4. IMAGE ANALYSIS

Segmentation, Thresholding, Edge based and Region based — shape representation and description — contour based and Region based texture- statistical texture description — syntactic texture description.

5. PATTERN RECOGNITION

Linear Discriminant Analysis- Baye's classifier — neural net- Feed forward, unsupervised learning, Hopfield nets- fuzzy system-optimization techniques in Recognition-Genetic algorithm- Simulated annealing.

REFERENCES:

1. Gonzaloz R. C. and Woods R.E., "Digital Image Processing", Prentice Hall 2002.
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UNIT I

Introduction-Scope of -Approaches to fault detection and diagnosis:-Model free methods and Model based methods -Introduction to Random variables-Distribution Bivariated distribution-Multivariate distribution-Normal distribution-Maximum likelihood distribution-Hypothesis testing

UNIT II

Analytical redundancy concept-Additive faults and disturbance-Multiplicative faults and disturbanceResidualgeneration-Detectionproperty-Isolationproperty Computational of Residual generation-Specification and implementation

UNIT III

Parity equation implementation of residual generator-Parity equation formulation Implementation of single residual-Implementation with input output relation-Fault system matrix Design for structure residual-Structural definition-Canonical structures-Handling disturbance-Residual structure for multiple faults

UNIT IV

Design for directional residual-Directional specifications-Parity equation-Linearly dependent colwnns Residual generation for parametric faults-Representation of parametric fault-Design for parametric fault and model errors-Robustness in residual generation-Perfect decoupling from disturbance

UNIT V

Advance topics: Fault diagnosis using Kalman filtering-Fault diagnosis using principle component analysis —Fault diagnosis using ANN and Fuzzy clustering

Case study: Aircraft fault detection

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