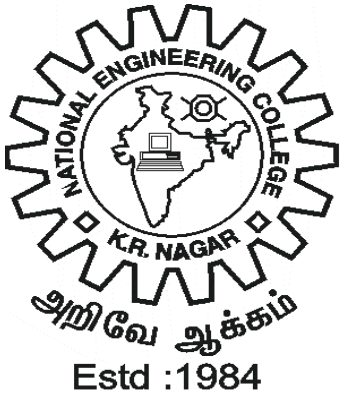
NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R.NAGAR, KOVILPATTI – 628 503

REGULATIONS - 2011



DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

CURRICULUM AND SYLLABI OF

M.E. – CONTROL AND INSTRUMENTATION

NATIONAL ENGINEERING COLLEGE, K.R.NAGAR, KOVILPATTI

(An Autonomous Institution Affiliated to Anna University Chennai)

M.E. CONTROL AND INSTRUMENTATION

CURRICULUM & SYLLABUS

SEMESTER I

SL. No.	Course Code	Course Title	L	T	P	C
1	MMA102	Applied Mathematics for Electrical Engineers	3	1	0	4
2	MCI101	Transducers and Measurements	3	0	0	3
3	MCI102	System theory	3	0	0	3
4	MCI103	Control System Design	3	1	0	4
5	MCI104	Micro controller based System Design	3	0	0	3
6	E1	Elective I	3	0	0	3
		TOTAL	18	2	0	20

SEMESTER II

SL. No.	Course Code	Course Title	L	T	P	C
THEORY						
1	MCI201	PC Based Instrumentation System Design	2	0	2	4
2	MCI202	Digital Instrumentation	3	0	0	3
3	MCI203	Process Dynamics and Control	3	1	0	4
4	MCI204	Nonlinear Control	3	0	0	3
5	E2	Elective II	3	0	0	3
6	E3	Elective III	3	0	0	3
PRACTICAL						
7	MCI231	Digital Control and Instrumentation Laboratory	0	0	3	2
		TOTAL	17	1	5	22

NATIONAL ENGINEERING COLLEGE, K.R.NAGAR, KOVILPATTI

(An Autonomous Institution Affiliated to Anna University Chennai)

M.E. CONTROL AND INSTRUMENTATION

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	MCI331	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
THEORY						
1	MCI431	Project Work Phase II	0	0	24	12
		TOTAL	0	0	24	12

L - Lecture hours T - Tutorial hours P-Practical hours C - Credit

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE – 69

NATIONAL ENGINEERING COLLEGE, K.R.NAGAR, KOVILPATTI

(An Autonomous Institution Affiliated to Anna University Chennai)

CURRICULUM FOR I TO VI SEMESTERS (PART TIME)

M.E. CONTROL AND INSTRUMENTATION

SEMESTER I (Part Time)

SL. No.	Course Code	Course Title	L	T	P	C
THEORY						
1	MMA102	Applied Mathematics for Electrical Engineers	3	1	0	4
2	MCI101	Transducers and Measurements	3	0	0	3
3	MCI102	System theory	3	0	0	3
		TOTAL	**9**	**1**	**0**	**10**

SEMESTER II (Part Time)

SL. No.	Course Code	Course Title	L	T	P	C
THEORY						
1	MCI201	PC Based Instrumentation System Design	2	0	2	4
2	MCI202	Digital Instrumentation	3	0	0	3
3	MCI203	Process Dynamics and Control	3	1	0	4
PRACTICAL						
4	MCI231	Digital Control and Instrumentation Laboratory	0	0	3	2
		TOTAL	**8**	**1**	**5**	**13**

SEMESTER III (Part Time)

SL. No.	Course Code	Course Title	L	T	P	C
THEORY						
1	MCI103	Control System Design	3	1	0	4
2	MCI104	Micro controller based System Design	3	0	0	3
3	E1	Elective - I	3	0	0	3
		TOTAL	**9**	**1**	**0**	**10**

SEMESTER IV (Part Time)

SL. No.	Course Code	Course Title	L	T	P	C
THEORY						
1	MCI204	Nonlinear Control	3	0	0	3
2	E2	Elective - II	3	0	0	3
3	E3	Elective - III	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER V (Part Time)

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	MCI331	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER VI (Part Time)

SL. No.	Course Code	Course Title	L	T	P	C
PRACTICAL						
1	MCI431	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE – 69

ELECTIVES FOR M.E CONTROL AND INSTRUMENTATION

SEMESTER – I (Elective 1)

SL. No.	Course Code	Course Title	L	T	P	C
1	MCI006	Micro Electro Mechanical Systems	3	0	0	3
2	MCI007	Principles of Robotics	3	0	0	3
3	MHV011	Soft Computing Techniques	3	0	0	3

SEMESTER – II (Elective 2 & 3)

SL. No.	Course Code	Course Title	L	T	P	C
1	MCI004	Multi Sensor Data Fusion	3	0	0	3
2	MCI014	Biomedical Engineering and Radiological Equipments	3	0	0	3
3	MCI015	Instrumentation for Non-Destructive Testing	3	0	0	3
4	MCI017	Power Plant Instrumentation	3	0	0	3
5	MCI018	Instrumentation in Pulp and Paper Industries	3	0	0	3
6	MCI019	Smart Sensors	3	0	0	3
7	MHV008	Electromagnetic Interference and Electromagnetic Compatibility	3	0	0	3

SEMESTER – III (Elective 4, 5 & 6)

SL. No.	Course Code	Course Title	L	T	P	C
1	MCI001	Advanced Digital System Design	3	0	0	3
2	MCE103	Advanced Digital Signal Processing	3	0	0	3
3	MCI003	Real Time Operating Systems	3	0	0	3
4	MCI005	Design of Embedded Systems	3	0	0	3
5	MCI008	Optimal Control and Filtering	3	0	0	3
6	MCI010	System Identification and Adaptive control	3	0	0	3
7	MCI011	Programming with VHDL	3	0	0	3
8	MCS017	Digital Imaging	3	0	0	3
9	MHV022	Control of Electric Drives	3	0	0	3

Special Elective Group for Ph.D Course Work

SL. No.	Course Code	Course Title	L	T	P	C
1	MCI009	Advanced Topics in Nonlinear Control	3	0	0	3
2	MCI013	Medical Image Processing	3	0	0	3
3	MCI016	Applications of MEMS Technology	3	0	0	3
4	MHV101	Electromagnetic Field Computation and Modelling	3	1	0	4
5	MHV021	Analysis of Power converters	3	0	0	3
6	MHV005	Special Electrical Machines	3	0	0	3

MMA102 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

L T P C 3 1 0 4

UNIT I ADVANCED MATRIX THEORY 9

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

UNIT II LINEAR PROGRAMMING 9

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

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 9

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

UNIT IV QUEUEING MODELS 9

Poisson Process – Markovian queues – Single and Multi Server Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service queue.

UNIT V COMPUTATIONAL METHODS IN ENGINEERING 9

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

L +T: 45+15 = 60

REFERENCES:

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

MCI101 TRANSDUCERS AND MEASUREMENTS L T P C 3 0 0 3

UNIT I RESISTIVE, INDUCTIVE AND CAPACITIVE ELEMENTS 9

Potentiometric, strain-gage and electrode elements – Inductive and Capacitive elements: structures, equivalent circuits and characteristics, single, differential and angle displacement elements, displacement to phase converters, and proximity elements, magnetostrictive elements, temperature instabilities and features.

UNIT II TRANSFORMER, ELECTRODYNAMIC, SERVO AND RESONANT ELEMENTS 9

Transformer elements: Single core, differential, rotating coil and synchro transformers, weak-field sensors - Electrodynamic elements: Moving-coil, variable-reluctance- - Resonant elements: vibrating strings, vibrating beams, vibrating cylinders, piezoelectric resonators, acoustical resonators, microwave cavity resonators.

UNIT III MECHANICAL, ACOUSTICAL AND FLOWMETERING ELEMENTS 9

Stresses state of diaphragm, dynamic characteristics of diaphragm, temperature drifts, sensitivity drifts, sensitivity to acceleration – Inertial mass elements: sensing and transduction elements of flowmeters, electromagnetic flowmeters, nanoelectrode electromagnetic flowmeters -ultrasonic elements – Acoustical elements: acoustical filters.

UNIT IV OPTICAL MICROSTRUCTURE SENSORS 9

Photo detectors: Thermal detectors, pneumatic detectors, pyroelectric detectors, photoemissive devices, photo conductive detectors, photo diodes, avalanche photo diodes, schottky photo diodes, photo transistors – Fiber optic sensors: Fibers as light guides, reflection sensors, Intrinsic multimode sensor, temperature sensor, phase modulated sensor, fiber optic gyroscopes and other fiber sensors.

UNIT V MISCELLANEOUS MINIATURE SENSORS 9

Magnetic sensors: Hall Effect sensors, magnetoresistors and other sensors – Solid state chemical sensors: Silicon based sensors, metal oxide sensors, solid electrolyte sensors, membranes – Electromechanical micro sensors and basic factors of design

TOTAL: 45 PERIODS

REFERENCES:

1. Alexander D Khazan, “Transducers and their elements – Design and application”, PTR Prentice Hall, 1994 UNIT IV
2. Pavel Ripka and Alois Tipek,“Modern sensors hand book”, Instrumentation and measurement series, ISTE Ltd., 2007
3. David Fraden. , PHI, 2004 “Hand book of Modern Sensors, Physics, Design and Applications”, Third Edition, Springer India Pvt.Ltd, 2006.

MCI102 SYSTEM THEORY L T P C 3 0 0 3

UNIT I STATE VARIABLE REPRESENTATION 9

Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity-No uniqueness of state model-State Diagrams-Physical System and State Assignment.

UNIT II SOLUTION OF STATE EQUATION 9

Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Evaluation of matrix exponential-System modes-Role of Eigenvalues and Eigenvectors.

UNIT III CONTROLLABILITY AND OBSERVABILITY 9

Controllability and Observability -Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility- System Realizations.

UNIT IV STABILTY 9

Introduction-Equilibrium Points-Stability in the sense of Lyapunov-BIBO Stability-Stability of LTI Systems-Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems-The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems-Krasovskii and Variable-Gradiant Method.

UNIT V MODEL CONTROL 9

Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems- The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

TOTAL: 45 PERIODS

REFERENCES:

1. M. Gopal, “Modern Control System Theory”, New Age International, 2005.
2. K. Ogatta, “Modern Control Engineering”, PHI, 2001.I
3. John S. Bay, “Fundamentals of Linear State Space Systems”, McGraw-Hill, 1999.
4. D. Roy Choudhury, “Modern Control Systems”, New Age International, 2005.
5. John J. D’Azzo, C. H. Houpis and S. N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, Taylor Francis, 2001.II
6. Z. Bubnicki, ”Modern Control Theory”, Springer, 2005.

MCI103 CONTROL SYSTEM DESIGN LT P C 3 1 0 4

UNIT I CONVENTIONAL DESIGN METHODS 9

Design specifications- PID controllers and compensators- Root locus based design- Bode based design-Design examples

UNIT II DESIGN IN DISCRETE DOMAIN 9

Sample and Hold-Digital equivalents-Impulse and step invariant transformations -Methods of discretisation - Effect of sampling- Direct discrete design – discrete root locus Design examples

UNIT III OPTIMAL CONTROL 9

Formation of optimal control problems-results of Calculus of variations- Hamiltonian formulation-solution of optimal control problems- Evaluation of Riccati's equation State and output Regulator problems-Design examples

UNIT IV DISCRETE STATE VARIABLE DESIGN 9

Discrete pole placement- state and output feedback-estimated state feedback-discrete optimal control- dynamic programming-Design examples

UNIT V STATE ESTIMATION 9

State Estimation Problem -State estimation- Luenberger's observer-noise characteristics-Kalman-Bucy filter-Separation Theorem-Controller Design-Wiener filter- Design examples.

L=45, T=15, Total= 60

REFERENCES

1. M. Gopal "Modern control system Theory" New Age International, 2005.
2. Benjamin C. Kuo "Digital control systems", Oxford University Press, 2001.V
3. G. F. Franklin, J. D. Powell and A. E. Naeini "Feedback Control of Dynamic Systems", PHI (Pearson), 2001.I
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI (Pearson), 2001.II
5. G. F. Franklin, J. D. Powell and M Workman, "Digital Control of Dynamic Systems", PHI (Pearson), 2001.I
6. B.D.O. Anderson and J.B. Moore., 'Optimal Filtering', Prentice hall Inc., N.J., 1979.
7. Loan D. Landau, Gianluca Zito," Digital Control Systems, Design, Identification and Implementation", Springer, 2006.

MCI104 MICRO CONTROLLER BASED SYSTEM DESIGN L T P C 3 0 0 3

UNIT I 8051 ARCHITECTURE 9

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

UNIT II 8051 PROGRAMMING 9

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming Interrupt Programming – RTOS for 8051 – RTOSLite – FullRTOS –Task creation and run – LCD digital clock/thermometer using FullRTOS

UNIT III PIC MICROCONTROLLER 9

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

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER 9

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

UNIT V SYSTEM DESIGN – CASE STUDY 9

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

TOTAL: 45 PERIODS

REFERENCES:

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

MCI201 PC BASED INSTRUMENTATION SYSTEM DESIGN L T P C 2 0 2 4

UNIT I DATA ACQUISITION AND INSTRUMENT INTERFACE 9

Programming and simulation of Building block of instrument Automation system – Signal analysis, I/O port configuration with instrument bus protocols - ADC, DAC, DIO, counters & timers, PC hardware structure, timing, interrupts, DMA, software and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols,.

UNIT II VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES 9

Block diagram and architecture of a virtual instrument, Graphical programming in data flow, comparison with conventional programming, Vis and sub-Vis, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DESIGN TEST & ANALYSIS 9

Spectral estimation using Fourier Transform, power spectrum, correlation methods, Stability analysis, Fault analysis –Sampling, Data Parity and error coding checks, Synchronization testing – Watch dog timer, DMA method – Realtime Clocking, Noise- Gaussian, White analysis.

UNIT IV PC BASED INSTRUMENTATION 9

Introduction - Evolution of signal standard – HART Communication protocol communication modes – HART networks – control system interface – HART commands – HART field controller implementation – HART and the OSI model

UNIT V SIMULATION OF PHYSICAL SYSTEMS 9

Simulation of linear & Non-linear models of systems, Hardware in loop simulation of physical systems using special softwares.

L=30, P=30, Total=60

REFERENCES:

1. K. Ogatta, “Modern control Engineering”, Fifth Edition, Perason education 2010.
2. Dorf and Bishop, “Modern Control Engineering”, Addison Weseley, 1998.
3. Dorf and Bishop, “Modern ControlSystems”, Prentice Hall, 2008.
4. Patrick H. Garrett,” High performance Instrumentation and Automation”, CRC Press, Taylor & Francis Group, 2005.
5. MAPLE V programming guide
6. MATLAB/SIMULINK user manual
7. MATHCAD/VIS SIM user manual.
8. LABVIEW simulation user manual

MCI202 DIGITAL INSTRUMENTATION L T P C 3 0 0 3

UNIT I DATA ACQUISITION SYSTEMS 9

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems –Counters – Modes of operation- Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi channel Data Acquisition systems.

UNIT II INTERFACING AND DATA TRANSMISSION 9

Data transmission systems – 8086 Microprocessor based system design – Peripheral Interfaces – Time Division Multiplexing (TDM) – Digital Modulation – Pulse Modulation – Pulse Code Format – Interface systems and standards – Communications.

UNIT III INSTRUMENTATION BUS 9

Introduction, Modem standards, Basic requirements of Instrument Bus standards, Bus communication, interrupt and data handshaking, Interoperability, interchangeability for RS-232, USB, RS-422, RS-48UNIT V

UNIT IV PARALLEL PORT BUSES 9

Field bus, Mod bus, GPIB, IEEE-488, VME, VXI, Network buses – Ethernet – TCP/IP protocols; CAN bus- basics, Message transfer, Fault confinement.

UNIT V CASE STUDIES 9

PC based DAS, Data loggers, PC based industrial process measurements like flow, temperature, pressure and level development system, CRT interface and controller with monochrome and colour video display.

TOTAL: 45 PERIODS

REFERENCES:

1. A.J. Bouwens, “Digital Instrumentation”, TATA McGraw-Hill Edition, 1998.
2. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice-Hall India, 2005.
3. H S Kalsi, “Electronic Instrumentation” Second Edition, Tata McGraw- Hill, 2006.
4. Joseph J. Carr, “Elements of Electronic Instrumentation and Measurement” Third Edition, Pearson Education, 2001.II
5. Buchanan, “Computer busses”, Arnold, London, 2000.
6. Jonathan W Valvano, “Embedded Microcomputer systems”, Asia Pvt. Ltd., Brooks/Cole, Thomson, 2001.

MCI203 PROCESS DYNAMICS AND CONTROL L T P C 3 1 0 4

UNIT I PROCESS DYNAMICS 12

Introduction to process control-objective of modelling-models of industrial processhydraulic tanks-fluid flow systems-mixing process-chemical reactions-thermal systemsheat exchangers and distillation column.

UNIT II CONTROL ACTIONS AND CONTROLLER TUNING 12

Basic control actions-on/off, P, P+I, P+I+D, floating control-pneumatic and electronic controllers- controller tuning-time response and frequency response methods- non-linear controllers.

UNIT III COMPLEX CONTROL TECHNIQUES 12

Feed forward-ratio-cascade-split range-inferential-predictive-adaptive and multivariable control.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 12

Evolution of PLC – Sequential and Programmable controllers – Architecture – Programming of PLC – Relay logic and Ladder logic – Functional blocks – Communication Networks for PLC.

UNIT V COMPUTER CONTROL OF PROCESSESS 12

PLC based control of processes – Computer control of liquid level system – heat exchanger – Smart sensors and Field bus.

TOTAL: 60 PERIODS

REFERENCES

1. George Stephanopolus, "Chemical Process Control", Prentice Hall India-1984.
2. K.Krishna Swamy, “Process Control”, New Age International, 2007.
3. Harriot P., “Process Control”, Tata McGraw-Hill, New Delhi, 1991.
4. Norman A Anderson,” Instrumentation for Process Measurement and Control” CRC Press LLC, Florida, 1998.
5. Marlin T.E., “Process Control”, Second Edition McGraw hill, New York, 2000.
6. Balchan J.G. and Mumme G., “Process Control Structures and Applications”, Van Nostrand Renhold Co., New York, 1988.
7. Lucas M.P, “Distributed Control System”, Van Nostrand Reinhold Co. NY 1986
8. Pertrezeulla, “Programmable Controllers”, McGraw-Hill, 1989
9. Chidambarm. M, “ Computer control of processes”, Narosa Publications, 2001.I

MCI204 NONLINEAR CONTROL L T P C 3 0 0 3

UNIT I PHASE PLANE ANALYSIS 9

Concepts of phase plane analysis- Phase portraits- singular points- Symmetry in phase plane portraits-Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems- Existence of Limit Cycles.

UNIT II DESCRIBING FUNCTION 9

Describing Function Fundamentals-Definitions – Assumptions - Computing Describing Functions -Common Nonlinearities and its Describing Functions-Nyquist Criterion and its Extension-Existence of Limit Cycles-Stability of limit Cycles.

UNIT III LYAPUNOV THEORY 9

Nonlinear Systems and Equilibrium Points-Concepts of Stability-Linearization and Local Stability-Lyapunov's Direct Method-Positive definite Functions and Lyapunov Functions-Equilibrium Point Theorems-Invariant Set Theorems-LTI System Analysis based on Lyapunov's Direct Method-Krasovski's Method-Variable Gradient Method-Physically –Control Design based on Lyapunov's Direct Method.

UNIT IV FEEDBACK LINEARIZATION 9

Feedback Linearization and the Canonical Form-Mathematical Tools-Input-State Linearization of SISO Systems- input-Output Linearization of SISO Systems-Generating a Linear Input-Output Relation-Normal Forms-The Zero-Dynamics-Stabilization and Tracking-Inverse Dynamics and Non-Minimum-Phase Systems-Feedback Linearization of MIMO Systems Zero-Dynamics and Control Design.

UNIT V SLIDING MODE CONTROL 9

Sliding Surfaces- Continuous approximations of Switching Control laws-The Modeling/ Performance Trade-Offs-MIMO Systems.

TOTAL : 45 PERIODS

REFERENCES

1. J A E Slotine and W Li, Applied Nonlinear control, PHI, 1991.
2. Hasan Khalil, "Nonlinear systems and control", Prentice Hall.2001.I
3. S H Zak, "Systems and control", Oxford University Press, 2001.II
4. Torkel Glad and Lennart Ljung, "Control Theory – Multivariable and Nonlinear Methods", Taylor & Francis, 2001.I
5. G. J. Thaler, "Automatic control systems", Jaico publishers, 1993.
6. P.Albertos, A. Sala," Multivariable Control System", Springer, 2004
7. Dominic William Jordan, Peter Smith,Non Linear ordinary Differential Equations- an introduction for scientist and engineers oxford university press, 2007.

MCI231 DIGITAL CONTROL AND INSTRUMENTATION LABORATORY

L T P C 0 0 3 2

1. Simulation of Converters
2. Simulation of Process Loop
3. Design of analog and digital interfaces
   - (i) Digital input,
   - (ii) Analog input,
   - (iii) Digital output ,
   - (iv) Analog output,
4. Design of analog and digital interfaces interrupts, timer handling.
5. Operation of on-off controlled thermal process
6. Design of controllers for linear systems
7. Design of controllers for non linear systems
8. Hardware in loop simulation of system.(serial interface)
   - (i) Distributed Control System (DCS)
   - (ii) ELVIS
   - (iii) Microcontroller
   - (iv) Programmable Logic Control (PLC)
9. Hardware in loop simulation of closed loop control system.

P = 45 Total= 45

MCI001 ADVANCED DIGITAL SYSTEM DESIGN L T P C 3 0 0 3

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modelling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization, Design of Arithmetic circuits for Fast adder- Array Multiplier.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits.

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA's – Fault in PLA – Test Generation – Masking Cycle – DFT Schemes – Built-in Self Test.

UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 9

Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence.

UNIT V NEW GENERATION PROGRAMMABLE LOGIC DEVICES 9

Foldback Architecture with GAL, EPLD, EPLA , PEEL, PML; PROM – Realization State machine using PLD – FPGA – Xilinx FPGA – Xilinx 2000 - Xilinx 3000

TOTAL: 45 PERIODS

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2001.I
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill –Higher Education, 2009.
3. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2001.V
4. Parag K Lala, "Digital System design using PLD", BS Publications, 2001.II
5. John M Yarbrough, "Digital Logic applications and Design", Thomson Learning, 2001.
6. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001.
7. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, Sixth Edition 2010.

MCE103 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes, Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes , ARMA, AR, MA , Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods , Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods , ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Linear prediction , Forward and Backward prediction, Solution of Prony's normal equations, Least mean-squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9

FIR adaptive filters, adaptive filter based on steepest descent method- Widrow-Hoff LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

Mathematical description of change of sampling rate , Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, Sampling rate conversion by a rational factor, Polyphase filter structures, Multistage implementation of multirate system, Application to subband coding , Wavelet transform

TOTAL: 45

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002 (First to Fourth Units)
2. Saeed V. Vaseghi, "Advanced Digital Signal Processing and Noise Reduction", 4th Edition, Wiley, 2009
3. John G. Proakis and Dimitris K Manolakis "Digital Signal Processing", Pearson Education, 4th Edition, 2009 (V-unit)
4. Richard G. Lyons "Understanding Digital Signal Processing" , Prentice Hall, 3rd Edition, 2010
5. Alan V. Oppenheim and Ronald W. Schafer "Discrete-Time Signal Processing" 3rd Edition, Prentice Hall, 2009.
6. Emmanuel C. Ifeachor, Barrie W. Jervis "Digital signal processing: A practical approach" 2nd Edition, Prentice Hall, 2002
7. Mallat.S., "Wavelet Signal Processing", Academic Press, Third Edition, 2008. (Wavelet Transform)

MCI003 REAL TIME OPERATING SYSTEMS L T P C 3 0 0 3

UNIT I REVIEW OF OPERATING SYSTEMS 9

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

UNIT II OVERVIEW OF RTOS 9

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

UNIT III REAL TIME MODELS AND LANGUAGES 9

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

UNIT IV REAL TIME KERNEL 9

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

UNIT V RTOS APPLICATION DOMAINS 9

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

TOTAL : 45 PERIODS

REFERENCES:

1. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
2. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, Second Edition 2011.
3. Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill 1997.
4. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, McGraw Hill, 2010.
5. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, PHI 1999.
6. Mukesh Sighal and N G Shi “Advanced Concepts in Operating System”, McGraw Hill 2001.

MCI004 MULTI SENSOR DATA FUSION L T P C 3 0 0 3

UNIT I MULTISENSOR DATA FUSION INTRODUCTION 9

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

UNIT II ALGORITHMS FOR DATA FUSION 9

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

UNIT III ESTIMATION 9

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

UNIT IV ADVANCED FILTERING 9

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

UNIT V HIGH PERFORMANCE DATA STRUCTURES 9

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

TOTAL : 45 PERIODS

REFERENCES:

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston, 2001.V
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.
3. Arthur Gelb, Applied Optimal Estimation, The M.I.T. Press, 1999.
4. James V. Candy, Signal Processing: The Model Based Approach, McGraw – Hill Book Company, 1987.

MCI005 DESIGN OF EMBEDDED SYSTEMS L T P C 3 0 0 3

UNIT I EMBEDDED DESIGN LIFE CYCLE 9

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

UNIT II PARTITIONING DECISION 9

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

UNIT III INTERRUPT SERVICE ROUTINES 9

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

UNIT IV IN CIRCUIT EMULATORS 9

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

UNIT V TESTING 9

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

TOTAL : 45 PERIODS

REFERENCE

1. Arnold S. Berger – “Embedded System Design”, CMP books, USA 2001.I
2. Sriram Iyer, “Embedded Real time System Programming” TATA McGraw Hill, 2001.II
3. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.
4. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006

MCI006 MICRO ELECTRO MECHANICAL SYSTEMS L T P C 3 0 0 3

UNIT I OVERVIEW OF MEMS 9

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

UNIT II MICRO FABRICATIONS AND MICROMACHINING 9

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

UNIT III PHYSICAL MICROSENSORS 9

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

UNIT IV MICROACTUATORS 9

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

UNIT V CASE STUDIES 9

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

TOTAL : 45 PERIODS

REFERENCES

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

MCI007 PRINCIPLES OF ROBOTICS L T P C 3 0 0 3

UNIT I INTRODUCTION AND TERMINOLOGIES 9

Definition-Classification-History- Robots components-Degrees of freedom-Robot jointscoordinates- Reference frames-workspace-Robot languages-actuators-sensors-Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensorsproximity and range sensors-social issues.

UNIT II KINEMATICS 9

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

UNIT III DIFFERENTIAL MOTION & VELOCITIES 9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Design-Lagrangian mechanics-dynamic equations-static force analysis.

UNIT IV ROBOT CONTROL SYSTEM 9

Sensor characteristics- Hydraulic, Pneumatic and electric actuators-trajectory planningdecentalised PID control- non-linear decoupling control.

UNIT V IMAGE PROCESSING & VISION SYSTEMS 9

Two and three dimensional images-spatial and frequency domain representation-noise and edges- convolution masks-Processing techniques-thersholding-noise reductionedge detection-segmentation-Image analysis and object recognition.

TOTAL : 45 PERIODS

REFERENCES

1. Saeed B. Niku ,"Introduction to Robotics ", Pearson Education, 2nd education 2010.
2. Fu, Gonzalez and Lee Mcgrahill ,"Robotics ", international TATA McGraw Hill, 2008.
3. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2001.II

MCI008 OPTIMAL CONTROL AND FILTERING L T P C 3 0 0 3

UNIT I INTRODUCTION 9

Statement of optimal control problem – Problem formulation and forms of optimal Control – Selection of performance measures. Necessary conditions for optimal control – Pontryagin's minimum principle – State inequality constraints – Minimum time problem.

UNIT II LQ CONTROL PROBLEMS AND DYNAMIC PROGRAMMING 9

Linear optimal regulator problem – Matrix Riccatti equation and solution method – Choice of weighting matrices – Steady state properties of optimal regulator – Linear tracking problem – LQG problem – Computational procedure for solving optimal control problems – Characteristics of dynamic programming solution – Dynamic programming application to discrete and continuous systems – Hamilton Jacobi Bellman equation.

UNIT III NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL 9

Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive Methods.

UNIT IV FILTERING AND ESTIMATION 9

Filtering – Linear system and estimation – System noise smoothing and prediction – Gauss Markov discrete time model – Estimation criteria – Minimum variance estimation – Least square estimation – Recursive estimation.

UNIT V KALMAN FILTER AND PROPERTIES 9

Filter problem and properties – Linear estimator property of Kalman Filter – Time invariance and asymptotic stability of filters – Time filtered estimates and signal to noise ratio improvement – Extended Kalman filter.

TOTAL : 45 PERIODS

REFERENCES:

1. KiRk D.E., 'Optimal Control Theory – An introduction', Prentice hall, N.J., 2nd edition 1998.
2. KiRk D.E., 'Optimal Control Theory – An introduction', Dover Pub,2001.V
3. Anderson, BD.O. And Moore J.B., 'Optimal Filtering', Prentice hall Inc., N.J., 2nd edition 2005.
4. S.M. Bozic, "Digital and Kalman Filtering", Edward Arnould, London, 2nd edition 1994.
5. Astrom, K.J., "Introduction to Stochastic Control Theory", Academic Press, Inc, N.Y., 1970.
6. David G.Hull., "Optimal control theory for Applications", Springer Publishing Company, 2001.V
7. D. Subbaram Naidu, "Optimal control systems", CRC Press (Aug 2002).

MCI009 ADVANCED TOPICS IN NONLINEAR CONTROL L T P C 3 0 0 3

UNIT I PERTURBATION THEORY 9

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

UNIT II SINGULAR PERTURBATIONS 9

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

UNIT III GAIN SCHEDULING AND FEEDBACK LINEARIZATION 9

Control problem – stabilization via linearization – integral control via linearization – gain scheduling – Input output linearization – Full state linearization – state feedback control – tracking- exercises.

UNIT IV INPUT-OUTPUT STABILITY 9

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

UNIT V BAKSTEPPING CONTROL ALGORITHMS 9

Passivity based control – High gain observers – stabilization – Regulation via integral control – exercises.

TOTAL : 45 PERIODS

REFERENCES

1. Hasan Khalil," Nonlinear systems and control", 3rd Ed, PHI, 2001.
2. Slotine, J A E Slotine and W Li, "Applied Nonlinear control",1991, PHI
3. S.H. Zak," Systems and control", Oxford University Press, 2001.II
4. T. P. Leung & H. S. Qin, “Advanced Topics in nonlinear control system”, World Scientific Publishing Co., Pvt. Ltd (2001).
5. M.Chidambaram, “Non Linear Process Control”, Wiley 1995.

MCI010 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL L T P C 3 0 0 3

UNIT I MODELS FOR IDENTIFICATION 9

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

UNIT II NON-PARAMETRIC AND PARAMETRIC IDENTIFICATON 9

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

UNIT III NON-LINEAR IDENTIFICATION AND MODEL VALIDATION 9

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

UNIT IV ADAPTIVE COTROL AND ADAPTATION TECHNIQUES 9

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

UNIT V CASE STUDIES 9

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

TOTAL : 45 PERIODS

REFERENCES

1. Ljung," System Identification Theory for the User", PHI, 2nd edition 1999.
2. Torsten Soderstrom, Petre Stoica, "System Identification", prentice Hall `International (UK) Ltd, 1989.
3. Astrom and Wittenmark," Adaptive Control ", PHI, 2nd edition 1995.
4. William S. Levine, "Control Hand Book". CRC Press, 2nd edition 2010.
5. Narendra and Annasamy," Stable Adaptive Control Systems, Prentice Hall, 1989.

MCI011 PROGRAMMING WITH VHDL L T P C 3 0 0 3

UNIT I VHDL FUNDAMENTALS 9

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

UNIT II DATA TYPES AND BASIC MODELING CONSTRUCTS 9

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

UNIT III SUBPROGRAMS , PACKAGES AND FILES 9

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

UNIT IV SIGNALS, COMPONENTS, CONFIGURATIONS 9

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

UNIT V DESIGN WITH PROGRAMMABLE LOGIC DEVICES 9

Realization of -Micro controller CPU.- Memories- I/O devices-MACDesign, synthesis, simulation and testing.

TOTAL : 45 PERIODS

REFERENCES

1. Peter J.Ashenden, “The Designer’s guide to VHDL”, Morgan Kaufmann publishers, San Francisco, third Edition, 2008.
2. Zainalabedin navabi, “VHDL Analysis ans modeling of Digital Systems”, McGraw Hill International Editions, Third Editions, 2007.
3. Charles H Roth, Jr. “Digital system Design using VHDL”, Thomson, 2nd edition 2007.
4. Douglas Perry, “VHDL Programming by Example”, Tata McGraw Hill,4th Edition 2001.I
5. Skahill. K, “VHDL for Programmable Logic”, Pearson education, 1996.

MCS017 DIGITAL IMAGING L T P C
3 0 0 3

Objectives:

1. To study the fundamentals of image processing.
2. To study the various image enhancement techniques.
3. To know the various image compression standards.
4. To know the applications of image processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models, File Formats, Image operations – Arithmetic, Geometric and Morphological.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain – Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening – Frequency Domain: Filtering in Frequency Domain – DFT – FFT – DCT – Smoothing and Sharpening filters – Homomorphic Filtering.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Morphological Water Sheds – Motion Segmentation – Feature Analysis and Extraction.

UNIT IV MULTI RESOLUTION ANALYSIS AND COMPRESSIONS 9

Multi Resolution Analysis – Image Pyramids – Multi resolution expansion – Wavelet Transforms – Image Compression – Fundamentals – Models – Elements of Information Theory – Error Free Compression – Lossy Compression – Compression Standards.

UNIT V APPLICATIONS OF IMAGE PROCESSING 9

Image Classification – Image Recognition – Image Understanding – Video Motion Analysis – Image Fusion – Steganography – Digital Compositing – Mosaics – Colour Image Processing.

TOTAL: 45

REFERENCES:

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing” 2nd Edition, Pearson Education, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, 2nd Edition, Thomson Learning, 2001.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2003.
4. Ron Patton, Software testing, 2nd Edition, Pearson education, 2007.
5. Alan C Gillies, “Software Quality Theory and Management”, Cengage Learning, 2nd Edition, 2003.

MCI013 MEDICAL IMAGE PROCESSING L T P C 3 0 0 3

UNIT I IMAGE FUNDAMENTALS 9

Image Perception, MTF of the visual system, Image Fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D- DFT and other transforms

UNIT II IMAGE PREPROCESSING 9

Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations, Image restoration- Image degradation model, Inverse and Weiner filtering , Image Compression- Spatial and Transform methods

UNIT III IMAGE RECONSTRUCTION IN MEDICAL IMAGING MODALITIES 9

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, Nuclear Medicine Imaging Modalities, Ultra sound imaging, 3D Ultra sound imaging

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation, Image representation and analysis, Feature extraction and representation, Statistical Shape, Texture, feature and Image classification- Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization- 2D display methods, 3D display methods, virtual reality based interactive visualization

TOTAL: 45 PERIODS

REFERENCES

1. Atam P.Dhawan , “Medical Image Analysis” Wiley Interscience Publication, NJ, USA 2003
2. R.C. Gonzalez and R.E woods , ‘Digital Image Processing’ , Second Edition, Pearson Education, 2002
3. Anil. K. Jain, “ Fundamentals of Digital Image Processing” Pearson education, Indian Reprint, 2002
4. Eric Krestel, “Image System for Medical diagnosis” Siemens Aktiengesell Schaft, Germany, 1990
5. Alfred Horowitz, ‘MRI Physics for Radiologists” – A Visual Approach’ , Second Edition Springer Vertag New York, 1991

MCI014 BIOMEDICAL ENGINEERING AND RADIOLOGICAL EQUIPMENTS

L T P C 3 0 0 3

UNIT I HUMAN PHYSIOLOGY 9

Cell and its structure – Skeletal system – Muscular system – Nervous system- Cardiovascular system – respiratory system – Basic components of a biomedical system – Transducers for physiological measurement – selection criteria of transducers.

UNIT II INTRODUCTION TO IMAGING TECHNIQUES 9

Basic imaging theory- The imaging equation- Position independence- Reductions from three to two dimensions – Noise – The Fourier transform and the convolution integral - Image reconstruction from profiles – Sampling theory.

UNIT III X-RAY AND OTHER IMAGING METHODS 9

Fundamentals of X-Ray, Angiography, Digital subtraction angiography, CT imaging techniques, Radionuclide imaging- Ultrasonic imaging – Magnetic Resonance Imaging- - Electrical Impedance Tomography – Positron Emission Tomography.

UNIT IV MATHEMATICAL AND STATISTICAL TECHNIQUES 9

Introduction and objectives- Useful preliminaries: some properties of trigonometric functions – Representation of deterministic signals – Discrete or sampled data- Applied statistics- Linear signal processing- problems.

UNIT V THERAPY USING X-RAYS AND ISOTOPES 9

Direct and Indirect effects of high energy radiation, Units for radiation Exposure, Depth Dose curves, Linear Accelerator, Betatron, Cobalt and Cesium Therapy , Computation of Absorbed Dose Level, Automatic Treatment Planning.

TOTAL: 45 PERIODS

REFERENCES:

1. Chesney D.N. and Chesney M.O. X-Ray Equipments for Radiographer, 2005.
2. Jacobson B. and Webster J.G. Medicine and Clinical Engineering, Prentice hall India, New Delhi, 1999.
3. Steve Webb, The Physics of Medical Imaging, Institute of Physics Publishing; 2Rev Ed edition (March 15, 2008).
4. Medical Physics and Biomedical Engineering, B H Brown, P V Lawford , R H Smallwood, D R Hose, D C Barber.
5. Chesney D.N. and Chesney M.O. “X-Ray Equipments for Students Radiographer”, Blackwell Scientific Publications Oxford , 1971.
6. B H Brown, P V Lawford , R H Smallwood, D R Hose, D C Barber, “Medical Physics and Biomedical Engineering” IOP publishers, 1999.
7. R.S.Khandpur, “Hand Book of Bio-Medical instrumentation”, Tata McGraw Hill Publishing Co Ltd., 2001.II
8. Arthur C.Guyton and John Edward Hall, “Textbook of Medical Physiology”, 12th Edition, Elsevier publication, 2010
9. Michael E Phelps, “PET – Physics, Instrumentation and Scanners”, Springer Publication, 2006.

MCI015 INSTRUMENTATION FOR NON-DESTRUCTIVE TESTING L T P C 3 0 0 3

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Conditions for effective non-destructive testing Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications.

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Inspection of Ferromagnetic materials –Instrumentation for pulsed eddy current techniques-Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Detectors and Equipments. Applications – Thermal Imaging for condition Monitoring of Industrial Components.

UNIT IV ULTRASONIC TESTING & RADIOGRAPHY 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks. Principle of Radiography, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography

UNIT V INDUSTRIAL APPLICATIONS, COMPARISON AND SELECTION OF NDT METHODS 9

Applications of NDE in Nuclear, Aircraft, Automotive and petroleum Industries. A Comparison and selection of various NDT techniques. Codes, standards, specification and procedures.

TOTAL: 45 PERIODS

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker, Inc., New York, 2002
4. www.ndt.net
5. Prasad J and C.G.K. Nair, “ Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008
6. Charles J. Hellier, “ Hand Book of Non-Destructive Evaluation”, The McGraw-Hill Companies, New York, 2001.II

MCI016 APPLICATIONS OF MEMS TECHNOLOGY L T P C 3 0 0 3

UNIT I MEMS: MICRO-FABRICATION, MATERIALS AND ELECTRO MECHANICAL CONCEPTS 9

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications

UNIT III THERMAL SENSING AND ACTUATION 9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors,thermal resistor sensors-Applications.

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials-Applications.

UNIT V CASE STUDIES 9

Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.

TOTAL : 45 PERIODS

REFERENCES

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
2. Marc Madou , “Fundamentals of microfabrication”,CRC Press, 3rd edition, 2011.
3. Boston , “Micromachined Transducers Sourcebook”,WCB McGraw Hill, 1998.
4. M.H.Bao “Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes”, Elsevier, New york, 2000.

MHV005 SPECIAL ELECTRICAL MACHINES L T P C 3 0 0 3

UNIT I STEPPING MOTOR 9

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

UNIT II SWITCHED RELUCTANCE MOTORS 9

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

UNIT III SYNCHRONOUS RELUCTANCE MOTORS 9

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

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTROS 9

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

UNIT V PERMANENT MAGNET BRUSHLESS DC MOTORS 9

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

TOTAL : 45 PERIODS

REFERENCES

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

MHV008 ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY L T P C 3 0 0 3

UNIT I INTRODUCTION 9

Sources of EMI, Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation- typical noise path- use of network theory- methods of eliminating interferences.

UNIT II METHOD OF HARDENING 9

Cabling –capacitive coupling- inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal groundssingle point and multipoint ground systems- hybrid grounds- functional ground layout – grounding of cable shields- ground loops-guard shields.

UNIT III BALANCING, FILTERING AND SHIELDING 9

Power supply decoupling- decoupling filters-amplifier filtering –high frequency filtering shielding – near and far fields- shielding effectiveness- absorption and reflection loss, Shielding with magnetic material- conductive gaskets, windows and coatings- grounding of shields.

UNIT IV DIGITAL CIRCUIT NOISE AND LAYOUT 9

Frequency versus time domain- analog versus digital circuits- digital logic noise- internal noise sources- digital circuit ground noise –power distribution-noise voltage objectives measuring noise voltages-unused inputs-logic families.

UNIT V ELECTROSTATIC DISCHARGE,STANDARDS AND LABORATORY TECHNIQUES 9

Static Generation- human body model- static discharges-ED protection in equipment design- ESD versus EMC, Industrial and Government standards – FCC requirements – CISPR recommendations-Laboratory techniques- Measurement methods for field strength-EMI.

TOTAL : 45 PERIODS

REFERENCES

1. Henry W.Ott, " Electro Magnetic Compatibility Engineering", John Wiley & Sons, First edition 2009.
2. Bernhard Keiser, "Principles of Electro-magnetic Compatibility", Artech House, Inc. (685 canton street, Norwood, MA 020062 USA) 1987.
3. Bridges, J.E Milleta J. and Ricketts.L.W., "EMP Radiation and Protective techniques", John Wiley and sons, USA 1976.
4. IEEE National Symposium on "Electromagnetic Compatibility", IEEE, 445, hoes Lane, Piscataiway, NJ 08855, 1989.

MHV011 SOFT COMPUTING TECHNIQUES L T P C 3 0 0 3

UNIT I INTRODUCTION 9

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

UNIT III FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT IV GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and anD-colony search techniques for solving optimization problems.

UNIT V APPLICATIONS 9

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TOTAL : 45 PERIODS

REFERENCES

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 2006.
2. KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, fourth edition 2001.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers, 1996.

MHV021 ANALYSIS OF POWER CONVERTERS L T P C 3 0 0 3

UNIT I SINGLE PHASE AC-DC CONVERTERS 9

Uncontrolled, half controlled and fully controlled with R-L, R-L-E loads and free wheeling diode - continuous and discontinuous modes of operation – inverter operation – Dual converter – Sequence control of converters – Performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap.

UNIT II THREE PHASE AC-DC CONVERTERS 9

Uncontrolled, half controlled and fully controlled with R-L, R-L-E loads and free wheeling diodes – Inverter operation and its limit – Dual converter – Performance parameter effect of source impedance and overlap.

UNIT III DC – DC CONVERTERS 9

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – Time ratio and current limit control – Full bridge converter – Resonant and Quasi-resonant converters.

UNIT IV DC – AC CONVERTERS 9

Voltage source inverters - Principle of operation of half and full bridge inverters – 180 degree and 120 degree conduction mode inverters – Voltage control of three phase inverters using various PWM techniques – Harmonics and various harmonic elimination techniques – Analysis with R-L, R-L-E loads – Multi level inverters.

UNIT V AC – AC CONVERTERS 9

Principle of operation of AC Voltage Controllers, Cycloconverters – Analysis with R-L, RL-E loads – Introduction to Matrix converters.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ned Mohan , Undeland and Robbin, “Power Electronics: Converters, Application and Design” A John Wiley and Sons, Inc., Newyork, third edition 2001.I
2. Rashid M.H . “Power Electronics Circuits , Devices and Applications”, Prentice Hall of India, New Delhi, third edition 2001.II

REFERENCES

1. P.C Sen .”Modern Power Electronics” Wheeler publishing Co ,First Edition ,New Delhi- 1998
2. P.S.Bimbra , “Power Electronics”, Khanna Publishers, Eleventh Edition , 2001.II
3. Bin Wu, “High Power Converters and AC Drives”, IEEE Press, A John Wiley and Sons, Inc., 2006.

MHV022 CONTROL OF ELECTRIC DRIVES L T P C 3 0 0 3

UNIT I CONVERTER FED DC DRIVES 9

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

UNIT II CHOPPER FED DC DRIVES 9

Microcontroller hardware circuits and waveforms of various modes of operation of chopper fed DC drives.

UNIT III INVERTER FED INDUCTION MOTOR DRIVE 9

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

UNIT IV MATHEMATICAL MODELING OF FREQUENCY CONTROLLED DRIVE 9

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

UNIT V CLOSED LOOP CONTROL OF MICROCOMPUTER BASED DRIVES 9

Voltage, Current, Torque and Speed measurements using digital measurement techniques. Types of controllers, position and velocity measurement algorithm, closed loop control of microcomputer based drives.

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. R.Krishnan, “Electric Motor Drives, Modeling, Analysis and Control” Prentice Hall of India, 2001.I
2. Bin Wu, “High Power Converters and AC Drives”, IEEE Press, A John Wiley and Sons, Inc., 2006.
3. Dubey G.K., Power semiconductor controlled drives, Prentice-HALL 1989.
4. Control of Electric Drives, Leonard W, Springer Verlag, NY, third edition 2001.
5. Bose B.K., Microcomputer control of power electronics and drives, IEEE Press, 1987.
6. Bose B.K., Adjustable Speed A.C. drives, IEEE Press, 1993.

MHV101 ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING

L T P C 3 1 0 4

UNIT I INTRODUCTION 9

Review of basic field theory – electric and magnetic fields – Maxwell's equations – Laplace, Poisson and Helmoltz equations – principle of energy conversion – force/torque calculation – Electro thermal formulation.

UNIT II SOLUTION OF FIELD EQUATIONS I 9

Limitations of the conventional design procedure, need for the field analysis based design, problem definition , solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

UNIT III SOLUTION OF FIELD EQUATIONS II 9

Finite element method (FEM) – Differential/ integral functions – Variation method – Energy minimization – Discretisation – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problem.

UNIT IV FIELD COMPUTATION FOR BASIC CONFIGURATIONS 9

Computation of electric and magnetic field intensities– Capacitance and Inductance – Force, Torque, Energy for basic configurations.

UNIT V DESIGN APPLICATIONS 9

Insulators- Bushings – Cylindrical magnetic actuators – Transformers – Rotating machines.

L=45: T=15, Total =60

REFERENCES

1. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, "The analytical and numerical solution of Electric and magnetic fields", John Wiley & Sons, 1993.
2. Nathan Ida, Joao P.A.Bastos , "Electromagnetics and calculation of fields", Springer-Verlage, second edition 2001.I
3. Nicola Biyanchi , "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 2005.
4. S.J Salon, "Finite Element Analysis of Electrical Machines." Kluwer Academic Publishers, London, 1995, distributed by TBH Publishers & Distributors, Chennai, India.
5. User manuals of MAGNET, MAXWELL & ANSYS software.
6. Silvester and Ferrari, "Finite Elements for Electrical Engineers" Cambridge University press, third Edition 1996.

MCI017 POWER PLANT INSTRUMENTATION L T P C 3 0 0 3

UNIT I OVERVIEW OF POWER GENERATION 9

Introduction to Economics of power generation - Brief survey of methods of power generation – Hydro, thermal, nuclear, wind power, Solar energy collectors, OTEC , tidal power plants and geothermal resources, fuel cell, MHD power generation-principle, thermoelectric power generation, Thermionic power generation - Cogeneration.

UNIT II CONTROL IN BOILERS 9

Basic types of steam generator, Economizer, Super heater, Re heater, Air preheater, Electrostatic precipitator, Deaeration, Boiler blow down. Boiler draft systems – Furnace draft - control of boilers – feed water control – coal fired boilers – fuel and air control - Main steam and reheat steam temperature control – Super heater control – Air temperature – De aerator.

UNIT III SOLAR ENERGY 9

Solar energy – Basics , solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety.

UNIT IV WIND AND GEOTHERMAL ENERGY 9

Power in wind, Conversion of wind power, Aerodynamics of wind turbine, types of wind turbine, and modes of operation, power control of wind turbines, wind mill, wind pumps, wind farms, different generator protections, troubleshooting & safety.

Types of Geothermal resources - analysis of geothermal resources – Environmental consideration.

UNIT VNUCLEAR POWER PLANT 9

Nuclear power generation, control station and reactor control .Maintenance of nuclear plant instrumentation- Nuclear plant temperature instrumentation – measurement terminology.

TOTAL : 45 PERIODS

REFERENCES

1. Sam G. Dukelow, ‘The Control of Boilers’, Instrument Society of America, 1991.
2. G.F. Gilman ,’Boiler Control Systems Engineering’., 2005, ISA Publication.
3. P.K. Nag, ‘Power Plant Engineering’, Tata McGraw Hill, Third edition, 2008.
4. E.Al. Wakil, ‘Power Plant Engineering’, Tata McGraw Hill, 1984.
5. B. H. Khan , ‘Non-conventional energy resources’., McGraw Hill, New Delhi.(2009).
6. H. M. Hashemian. Maintenance of process instrumentation in nuclear power plants Springer 2006.
7. S. P. Sukhatme, ‘Solar Energy’, Tata McGraw Hill, New Delhi.(1996).

MCI018 INSTRUMENTATION IN PULP AND PAPER INDUSTRIES

L T P C 3 0 0 3

UNIT I AN OVERVIEW OF PAPER MAKING PROCESS 9

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.

UNIT II PAPER PROPERTIES AND ITS MEASUREMENT 9

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, color, gloss and capacity — Starch constant acidity and pH - Measurement techniques.

UNIT III CONSISTENCY MEASUREMENT 9

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

UNIT IV PAPER MAKING MACHINE 9

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

UNIT V CONTROL ASPECTS 9

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

` **TOTAL : 45 PERIODS**

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.

MCI019 SMART SENSORS L T P C 3 0 0 3

UNIT I OVER VIEW OF SMART SENSOR SYSTEMS 9

Definitions for Several Kinds of Sensors- Automated Production Machines - Automated Consumer Products. Interface Electronics and Measurement Techniques for Smart Sensor Systems: Object-oriented Design of Sensor Systems - Sensing Elements and Their Parasitic Effects - Analog-to-digital Conversion - A Universal Transducer Interface.

UNIT II SILICON SENSORS, OPTICAL SENSORS & PHYSICAL CHEMO SENSORS 9

Silicon Sensors: Introduction- Measurement and Control Systems- Transducers.

Optical Sensors: Introduction - Photon Absorption in Silicon – Interfacing of Photon Transmission into Silicon - Photon Detection in Silicon Photoconductors - Photon Detection in Silicon pn Junctions.

Physical Chemosensors: Introduction - Physical Chemosensing - Energy Domains - Examples and Applications.

UNIT III SMART TEMPERATURE SENSORS, CAPACITIVE SENSORS & HALL MAGNETIC SENSORS 9

Smart Temperature Sensors and Temperature-Sensor Systems: Introduction - Resistive Temperature-sensing Elements - Temperature-sensor Features of Transistors - Smart Temperature Sensors and Systems.

Capacitive Sensors: Basics of Capacitive Sensors - The Design of Electrode Configurations - Selectivity for Electrical Signals and Electrical Parameters.

Integrated Hall Magnetic Sensors: Hall Effect and Hall Elements - Integrated Hall Sensor Systems.

UNIT IV UNIVERSAL ASYNCHRONOUS SENSOR INTERFACES AND DAQ 9

Universal Sensor Interfaces - Asynchronous Converters - Dealing with Problems of Low-cost Design of Universal Interface ICs - Front-end Circuits.

Data Acquisition for Frequency- and Time-domain Sensors: DAQ Boards - Design for Quasi-digital Sensors - Universal Frequency-to-digital Converters (UFDC).

UNIT V MICROCONTROLLERS AND DIGITAL SIGNAL PROCESSORS FOR SMART SENSOR SYSTEMS 9

Introduction - MCU and DSP Architectures, Organization, Structures, and Peripherals - Choosing a Low-Power MCU or DSP - Timer Modules - Analog Comparators, ADCs, and DACs as Modules of Microcontrollers - Embedded Networks and LCD Interfacing - Development Tools and Support.

TOTAL: 45 PERIODS

REFERENCES

1. Gerard C.M. Meijer, ‘Smart Sensor System’, A John Wiley and Sons Ltd, 2008.
2. Sergey Y. Yurish, Maria T.S.R. Gomes and Maria Teresa S.R. Gomes, ‘Smart Sensors and MEMS’, Klumer Academic Publishers, 2001.V