

**AFFILIATED INSTITUTIONS
ANNA UNIVERSITY, CHENNAI**

REGULATIONS - 2009

CURRICULUM AND SYLLABUS I SEMESTER & ELECTIVES

M.E. CONTROL AND INSTRUMENTATION ENGINEERING

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA 9314	Applied Mathematics for Electrical Engineers	3	1	0	4
2.	CL 9311	Transducers and Measurements	3	0	0	3
3.	CL 9312	System Theory	3	0	0	3
4.	CL 9313	Control System Design	3	1	0	4
5.	CL 9314	Micro controller based System Design	3	0	0	3
6.	E1	Elective I	3	0	0	3
TOTAL			18	2	0	20

ELECTIVES FOR M.E CONTROL AND INSTRUMENTATION

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CL 9001	Advanced Digital System Design	3	0	0	3
2.	CL 9002	Soft Computing Techniques	3	0	0	3
3.	CL 9003	Analysis of Power converters	3	0	0	3

- 1. ADVANCED MATRIX THEORY: 9**
Eigen-values using QR transformations – Generalized eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.
- 2. LINEAR PROGRAMMING 9**
Formulation – Graphical Solution – Simplex Method – Two Phase Method – Transportation and Assignment Problems.
- 3. 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.
- 4. QUEUEING MODELS 9**
Poisson Process – Markovian queues – Single and Multi Server Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service queue.
- 5. 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, 200

- 1. 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.
- 2. TRANSFORMER, ELECTRODYNAMIC, SERVO AND RESONANT ELEMENTS 9**
Transformer elements: Single core, differential, rotating coil and synchro transformers, weak-field sensors - Electrodynamical elements: Moving-coil, variable-reluctance- - Resonant elements: vibrating strings, vibrating beams, vibrating cylinders, piezoelectric resonators, acoustical resonators, microwave cavity resonators.
- 3. 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.
- 4. 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
- 5. 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.
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.

- 1. 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.
- 2. 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.
- 3. 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.
- 4. 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-Gradient Method.
- 5. MODAL 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, 2002.
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, 2003.
6. Z. Bubnicki, "Modern Control Theory", Springer, 2005.

1. CONVENTIONAL DESIGN METHODS 9

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

2. 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

3. 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

4. DISCRETE STATE VARIABLE DESIGN 9

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

5. 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, 2004.
3. G. F. Franklin, J. D. Powell and A. E. Naeini "Feedback Control of Dynamic Systems", PHI (Pearson), 2002.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI (Pearson), 2003.
5. G. F. Franklin, J. D. Powell and M Workman, "Digital Control of Dynamic Systems", PHI (Pearson), 2002.
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.

AIM

To expose the students to the fundamentals of microcontroller based system design.

OBJECTIVES

To impart knowledge on

- i. 8051 Microcontroller based system design.
- ii. Microchip PIC 8 bit microcontroller based system Design

- | | |
|--|----------|
| 1. 8051 ARCHITECTURE | 9 |
| Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication. | |
| 2. 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 | |
| 3. PIC MICROCONTROLLER | 9 |
| Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MP-LAB. | |
| 4. PERIPHERAL OF PIC MICROCONTROLLER | 9 |
| Timers – Interrupts, I/O ports- I ² C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories. | |
| 5. 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.

AIM

To expose the students to the fundamentals of digital logic based system design.

OBJECTIVES

To impart knowledge on

- i. Basics on Synchronous & Async digital switching design.
- ii. Design & realisation of error free functional blocks for digital systems

1. 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.

2. 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.

3. 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.

4. 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.

5. 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 2002.
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill, 2002
3. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
4. Parag K Lala, "Digital System design using PLD", BS Publications, 2003
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, 2004.

1. INTRODUCTION**9**

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

2. 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

3. 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.

4. 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.

5. 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, 1999.
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, 1994.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.

1. 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.

2. 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.

3. 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.

4. 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.

5. AC – AC CONVERTERS 9

Principle of operation of AC Voltage Controllers, Cycloconverters – Analysis with R-L, R-L-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, 1995
2. Rashid M.H . “Power Electronics Circuits , Devices and Applications”, Prentice Hall of India, New Delhi, 1995

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 , 2003.
3. Bin Wu, “High Power Converters and AC Drives”, IEEE Press, A John Wiley and Sons, Inc., 2006.