COURSE STRUCTURE AND SYALLABUS
M. TECH. (Control Systems)

I SEMESTER

Code	Group	Subject	L	P	Cred
		Advanced control Systems	3	0	3
		Digital control Systems	3	0	3
		Advanced Micro Processor	3	0	3
		State & Parameter Estimation Theory	3	0	3
	Elective -I	Advanced Instrumentation Systems Embedded Systems	3	0	3
	Elective -II	Programmable logic controllers and their applications Reliability Engineering	3	0	3
	Lab	control system Lab	0	3	2
		Seminar	-	-	2
		Total Credits (6 Theory + 1 Lab.)			22

ADVANCED CONTROL SYSTEMS

Unit I

Control System Design by the root locus method-lead, lag and lag-lead compensation, PI, PD, PID Controllers design procedures and examples.

Unit II

Control System Design by frequency response approach-lead, lag lag-lead compensation, PI, PD, PID Controllers – design procedures and examples.

Unit III: Eigen value and Eigen vector sensitivities in linear systems theory:

Continuous time systems: Introduction, first – order Eigen value sensitivities, first – order eigen vector sensitivities, second order eigen value sensitivities, second – order eigen vector sensitivities

Unit IV Mode – Controllability matrix:

Distinct eigen values, confluent eigen values associated with a single Jordan block, confluent eigen values associated with a number of distinct Jordan blocks, confluent eigen values associated with a number of non- distinct Jordan blocks

Unit V Mode – Controllability structure of multivariable linear systems:

Introduction, Distinct eigen values, confluent eigen values associated with single Jordan block, confluent eigen values associated with a number of distinct Jordan blocks

Unit VI Mode –Observability matrices:

Distinct eigen values, confluent eigen values, mode observability structure of multi variable linear system: Introduction, Distinct eigen values, confluent eigen values

Unit VII Non linear systems:

Common physical non-linearities; the phase-plane method-basic concepts, singular points, construction of phase trajectories-Isocline and Delta methods. Describing function-basic concept-derivation of describing functions-stability analysis by describing function method.

Unit VIII Lyapunov stability analysis:

Second method of Lyapunov, stability in the sense of Lyapunov, construction of Lyapunov function-Krasovskii's and variable gradient methods. Lyapunov stability analysis of linear time-invariant systems.

Reference Books:

1. Modern Control Engineering - K.Ogata – PHI - 3rd edition.
2. Control Systems Engineering – I.J.Nagrath, M.Gopal – New Age International - 3rd edition.
3. Control Systems – N.K.Sinha - New Age International - 3rd edition,
4. Automatic Control Systems – B.C.Kuo – PHI – 7th edition.
5. Modern Control Systems – HSU & MEYER
6. Modal control theory and applications Brian porter& Roger crossley

DIGITAL CONTROL SYSTEMS

UNIT-1: Introduction to Digital Control systems

Advantages of Digital control systems- -Practical aspects of the choice of sampling rate- Basic discrete time signals - Quantization – Sampling theorem -Data conversion and Quantization- Sampling process- Mathematical modeling- Data reconstruction and filtering of sampled signals – zero-order hold

UNIT II- z transform and inverse z transform Relationship between s- plane and z- plane- Difference equation-Solution by recursion and z-transform- pulse transfer functions of the zero-order Hold and relationship between G(s) and G(z)– Bilinear transformation .

UNIT-III: Analysis of Digital Control Systems

Digital control systems- Pulse transfer function- z transform analysis of open loop, closed loop systems- UNIT IV :- Modified z- transfer function- Stability of linear digital control systems- Stability tests- Steady-state error analysis- Root loci - Frequency domain analysis- Bode plots- Gain margin and phase margin

UNIT-V: Classical Design of Digital Control Systems

Cascade and feedback compensation by continuous data controllers- Digital controllers-Design using bilinear transformation- Root locus based design- Digital PID controllers- Dead beat control design- Case study examples using MATLAB

UNIT-VI: State Space Analysis of Digital Control Systems

State equations of discrete data systems with Sample and Hold devices, state equations of digital systems with all digital elements, State transition equation: Z transform method. Relation between state equations and transfer function's.

UNIT VII:- Concepts on Controlability and Observability. Digital state observer :

Design of the full order and reduced order state observer- Pole placement design by state feed back (single input and multi input). Design of discrete data systems with dead beat response.

UNIT-VIII: Optimal Digital Control: Formulation of the optimum control problem-Quadratic integral and matrix differential equations-The optimum gain matrix-Kalman filter is an observer-Kalman filter gain and variance equations.

Reference books:

1. B.C Kuo, Digital Control Systems (second Edition), Oxford University Press, Inc., New York, 1992.
2. G.F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison-Wesley Longman, Inc., Menlo Park, CA , 1998.
3. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill Publishing Company, 1997.
4. John F. Walkerly, Microcomputer architecture and Programs, John Wiley and Sons Inc., New York, 1981.
5. K. Ogata, Discrete Time Control Systems, Addison-Wesley Longman Pte. Ltd., Indian Branch, Delhi, 1995.
6. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill Book Company, 1985.
7. Fundamentals of Linear State Space Systems – John S. Baey – Mc. Graw-Hill - 1st edition
8. Control System Design – Bernard Fried Land – Mc. Graw-Hill - 1st edition
9. Continuous and Discrete Control Systems-Dorsay- Mc-Graw-Hill

ADVANCED MICROPROCESSORS

Unit I Intel 8086/8088

Architecture, its register organization, Pin diagram, Minimum and Maximum Mode System and Timings,
UNIT II:- Intel 8086/8088
Machine language instruction formats, Addressing modes, Instruction set, Assembler directives and operators.

Unit III ALP and special Architecture Features

ALP, programming with an assembler, stack structure, Interrupts, Service subroutines and Interrupt programming and Macros.

Unit IV Multiprocessor systems

Inter connection topologies, Numeric Processor 8087, I/O Processor 8089,
UNIT –V:- Bus arbitration and control Design of PC Based Multiprocessor system, Virtual Memory, Paging, Segmentation

Unit VI Advanced Processors

Architectural features of 80386, 486 and Pentium Processors their memory management, Introduction to Pentium Pro Processors their features,

UNIT VII:-RISC Vs CISC Processors, RISC properties, evaluation, Architectural features of DEC alpha AXP, Power PC family and Sun SPARC family systems.

Unit V III Microcontroller

Microcontrollers – 8051 architecture, Hardware feature, Interrupts, Addressing modes, instruction set – Programming – Applications.

Reference books:

1. Intel Microprocessors, Architecture, Programming and interfacing 8086/8088, 80186, 80386 and 80486 – Barry B.Brey, PHI-5th Edition –2001
2. Advanced Microprocessors – TABAK – McGraw Hill Inc, 2nd Edition
3. 8051 Microcontroller – Architecture Programming & Applications – K.J.Ayala - Penram Intl.
4. Programming & Customizing the 8051 Microcontroller- Myke Pretko- TMH, 1st Edition, 1999.
5. The 8088 and 8086 Microprocessor- W.A. Triebel & Avtar Singh- PHI, 4th Edition, 2002

STATE AND PARAMETER ESTIMATION THEORY

UNIT – I
Maximum likelihood method, Invariance of maximum likelihood estimator, Bayes cost methods: Mean square error (Minimum error variance) method,
UNIT II:- uniform cost method, Absolute cost method, relationships of these estimators.

UNIT – III
Linear minimum variance method, least square method, sequential estimation,

UNIT IV Non linear estimation, unbiased estimators, efficient estimators, asymptotic properties, sensitivity and error analysis.

UNIT – V
Gauss- Markov discrete time model, initial state description, propagations of means and co variances,

UNIT VI :-signal model, state statistics, output statistics, Estimation criteria, minimum variance estimate.

UNIT – VII
Discrete time kalman filter, best linear estimator property of kalman filter, identification as a Kalman filtering problem, Kalman filter applications.

UNIT – VIII
Fixed point smoothing, fixed log smoothing, fixed interval smoothing, extended kalman filter.

Reference Books:

1. J.L.Melsa, Decision and Estimation theory, International student Edition, Mc Graw Hill-Kogakusha(Chapters 8,9,10 & 11).
2. B.D.O.Anderson and J.B.Moore, Optimal filtering, Prentice- Hall.(Chapters 2,3& 7)
3. J.S. Meditch, Stochastic Optimal linear estimation and control, Mc Graw Hill, 1969.
4. Van Trees H.L., Detection, Estimation and Modulation Theory, Part 1&2 John Wiley sons, 1968/1971/1972.
5. Deutsch .R., Estimation Theory, Prentice Hall, 1965
6. Jazwinski.A.H. Stochastic processes& Filtering Theory, Academic press, 1970.
7. S.M.Bozic, Digital & Kalman Filtering, Edward Arnold Publishers Ltd., London

ADVANCED INSTRUMENTATION SYSTEMS
(Elective –I)

UNIT- I: Passive Electrical Transducers
Resistive Transducers- Resistance Thermometers- Hot wire resistance Transducers- Resistive displacement Transducers- Resistive strain Transducers- Resistive magnetic flux Transducers- Resistive optical radiation Transducers- Inductive Thickness Transducers- Inductive displacement Transducers- Capacitive Thickness Transducers- Capacitive displacement Transducers**.**

UNIT- II: Active Electrical Transducers -I
Thermoelectric Transducers- Piezo electric phenomenon- Piezo electric materials- Piezo electric torque Transducers- Piezo electric Acceleration transducers- Magnetostrictive phenomenon- Magnetostrictive Acceleration transducers- Hall effect Transducers- Tachometers- variable reluctance tachometers- Electromagnetic Flow meter.

UNIT- III: Active Electrical Transducers –II
Photoelectric phenomenon- photoconductive Transducers- photovoltaic Transducers- Photo emissive Transducers- Ionization vacuum gauges- Ionization displacement Transducers- Digital displacement Transducers- Digital Tachometers- Electromechanical Transducers.

UNIT-IV: Feedback Transducer systems
Feedback fundamentals- Inverse Transducers- Temperature balance system- self-balancing potentiometers- self-balancing bridges- servo-operated manometer- Feedback pneumatic load cell- servo-operated electromagnetic flow meter- feedback accelerometer system- Non-contact position measurement.

UNIT-V: Signals and their representation
Laplace and Fourier Transforms- standard test signals- Periodic signals- aperiodic signals- bandwidth- modulated signals- sampled data pulse modulation.

UNIT-VI: Data Acquisition Systems
General configurations- single and multichannel DAS- A/D converters (successive approximation and dual slope integration)- sample and hold circuits- Anti alia filters- multiplexers and demultiplexers- Digital multiplexers.

UNIT-VII: Data Transmission and Telemetry
Characteristics of a Telemetry system- landline telemetry- radio telemetry- frequency division multiplexing- time division multiplexing.

UNIT-VIII: Data Display and recording systems
Data loggers- Analog indicators- Digital Readout systems- analog recorders- magnetic tape recorders- direct recording- frequency modulation recording- digital recording technique- floppy discs.

Reference Books:
1. D.V.S.murthy, “Transducers & Instrumentation” Prentice Hall of India pvt. Ltd., First edition- 1995
2. C S Rangan- G R Sarma- V S V Mani, “Instrumentation Devices & Systems”, TMH- 2nd edition- 2003

EMBEDDED SYSTEMS
(Elective-I)

UNIT- I Overview of Embedded System:

Embedded System, types of Embedded System, Requirements of Embedded System,

UNIT II;- Issues in Embedded software development, Applications.

UNIT-III: Processor & Memory Organization:

Structural units in a processor, Processor selection, Memory devices, Memory selection, Memory Allocation & Map; Interfacing

UNIT-IV: Devices, Device Drivers & Buses for Device Networks:

I/O devices, Timer & Counter devices, Serial Communication, Communication between devices using different buses.

UNIT V;-Device drives, Parallel and serial port device drives in a system, Interrupt servicing mechanism, context and periods for context switching, Deadline and Interrupt Latency.

UNIT-VI: Programming & Program Modeling Concepts

Program elements, Modeling Processes for Software Analysis, Programming Models, Modeling of Multiprocessor Systems,

UNIT VII Software algorithm Concepts, design, implementation, testing, validating, debugging, Management and maintenance, Necessicity of RTOS.

UNIT-VIII: Hardware and Software Co-Design

Embedded system design and co design issues in software development, design cycle in development phase for Embedded System, Use of ICE & Software tools for development of ES, Issues in embedded system design.

REFERENCE BOOKS:

1. Embedded Systems: Architecture, Programming and Design – Rajkamal, TMH 2003
2. Programming for Embedded System: DreamTech Software Team-John Wiley -2002

PROGRAMMABLE LOGIC CONTROLLERS AND THEIR APPLICATIONS
(Elective-II)

Unit-I:
PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.

Unit-II:
PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation.

Unit-III: LADDER DIAGRAMS:
Digital logic gates, programming in the Boolean algebra system, conversion examples
Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

Unit-IV:
PLC Resisters: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

Unit-V:
PLC Functions: Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions

Unit-VI:
Data Handling functions: SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications

Unit-VII:
Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions.

Unit-VIII:
Analog PLC operation: Analog modules& systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, positions indicator with PID control, PID Modules, PID tuning, PID functions.

Reference Books:

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI

2. Programmable Logic Controllers- Programming Method and Applications –JR.Hackworth &F.D Hackworth Jr. –Pearson, 2004

RELIABILITY ENGINEERING
(ELECTIVE-II)

Unit 1:

Elements of probability theory

Probability distributions : Random variables, density and distribution functions. Mathematical expectation. Binominal distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

Unit 2:

Definition of Reliability. Significance of the terms appearing in the definition.

Component reliability, Hazard rate, derivation of the reliability function in terms of the hazarad rate. Hazard models.

Unit 3:

Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failues). Modes of failure. Bath tub curve. Effect of preventive maintenance. Measures of reliability: mean time to failure and mean time between failures.

Unit 4:

Reliability logic diagrams (reliability block diagrams)

Classification of engineering systems: series, parallel, series-parallel, parallel-series and non-series-parallel configurations. Expressions for the reliability of the basic configurations.

Unit 5:

Reliability evaluation of Non-series-parallel configurations: minimal tie-set, minimal cut-set and decomposition methods. Deduction of the minimal cutsets from the minimal pathsets.

Unit 6:

Discrete Markov Chains: General modelling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation. Absorbing states.

Unit 7:

Continuous Markov Processes: Modelling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating limiting state Probabilities.

Reliability evaluation of repairable systems.

Unit 8:

Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutset/failure mode approach.

TEXT BOOKS :

1. " RELIABILITY EVALUATION OF ENGINEERING SYSTEMS", Roy Billinton and Ronald N Allan, Plenum Press

CONTROL SYSTEMS LAB.

Any Ten experiments from the following can be conducted.

1. Temperature Controller using PID
2. Characteristics of Magnetic amplifiers
3. Characteristics of AC servo motor
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on a second order systems
7. Lag and lead compensation – Magnitude and phase plot
8. Transfer function of DC generator
9. Time response of Second order system
10. Characteristics of Synchros
11. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
12. Linear system analysis (Time domain analysis, Error analysis) using MATLAB
13. Stability analysis (Bode. Root Locus, Nyquist) of Linear Time Invariant system using MATLAB.
14. State space model for classical transfer function using MATLAB -Verification.
15. Microprocessor based stepper motor control.

REFERENCE BOOKS.

1. Simulation of Electrical and electronics Circuits using PSPICE – by M.H. Rashid. M/s PHI Publications.
2. PSPICE A/D user's manual – Microsim USA
3. PSPICE reference guide – Microsim , USA
4. MATLAB and it stool Books user's manual and – Mathworks, USA