SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
M.Tech (CS)
COURSE STRUCTURE

I Year – I Semester

S.No.	Course code	Subject	L	T	P	CP
1.	16EE7501	System Theory	4	0	-	4
2.	16EC5501	Micro Controllers and Interfacing	4	0	-	4
3.	16EE7502	Digital Control Systems	4	0	-	4
4.	16EE7503	Soft Computing Techniques	4	0	-	4
ELECTIVE-I						
5.	16EE7504	Robot Modeling Control	4	0	-	4
6.	16EE7505	Advanced Instrumentation Systems				
ELECTIVE- II						
7.	16EE4301	Principles of Machine Modeling and Analysis	4	0	-	4
8.	16EE7506	Sensors and Signal Conditioning				
LABORATORY						
10.	16EE7507	Control System Lab	-	-	4	2
		Contact periods / week	24	0	4	26
			Total/Week 28			

I Year – II Semester

S.No.	Course code	Subject	L	T	P	CP
1.	16EE7508	Process Dynamic and Control	4	0	-	4
2.	16EE7509	Non-Linear Control Theory	4	0	-	4
3.	16EE7510	Optimal Control Theory	4	0	-	4
4.	16EE7511	Advanced Digital Signal Processing	4	0	-	4
ELECTIVE- III						
5.	16EE7512	Adaptive Learning and Control	4	0	-	4
6.	16EE7513	Robust Control				
ELECTIVE- IV						
7.	16EE7514	Power Plant Instrumentation	4	0	-	4
8.	16EE7515	Industrial Instrumentation				
LABORATORY 1						
9.	16EE7516	Advanced Control Systems Lab	-	-	4	2
		Contact Periods / Week	24	0	4	26
			Total/Week 28			

II YEAR (III & IV Semesters)

S. No	Subject Code	Subject	Credits
1	16EE7517	Seminar	2
2	16EE7518	Project work	16

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7501) SYSTEM THEORY

M.Tech I Year -I Sem. (CS)	**L**	**T**	**C**
	4	**-**	**4**

UNIT-I

Introductory matrix algebra and linear vector space, State space representation of systems, Linearization of a non-linear System, Solution of state equations, Evaluation of State Transition Matrix (STM), Simulation of state equation using MATLAB / SIMULINK program, Similarity transformation and invariance of system properties due to similarity transformations, Minimal realization of SISO, SIMO, MISO transfer functions, Discretization of a continuous time state space model, Conversion of state space model to transfer function model using Fadeeva algorithm.

UNIT- II

Fundamental theorem of feedback control, Controllability and Controllable canonical form, Pole assignment by state feedback using Ackermann's formula, Eigen structure assignment problem.

UNIT- III

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using eigenvalue and eigen vector methods, iterative method, Controller design using output feedback.

UNIT-IV

Observability and observable canonical form, Design of full order observer using Ackermann's formula, Bass Gura algorithm, Duality between controllability and observability, Full order Observer based controller design, Reduced order observer design.

UNIT-V

Internal stability of a system, Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems, Solution of Lyapunov type equation. Model decomposition and decoupling by state feedback, Disturbance rejection, sensitivity and complementary sensitivity functions.

TEXT BOOKS:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T.,Linear Systems, Perntice Hall, Englewood Cliffs, NJ, 1980.
3. N. K. Sinha, Control Systems, New Age International, 3rd edition, 2005.

REFERENCES:

1. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New age international(P) LTD. Publishers, 2009.
2. John J D'Azzo and C. H. Houpis, "Linear Control System Analysis and Design Conventional and Modern", McGraw, Hill Book Company, 1988.
3. B.N. Dutta, Numerical Methods for linear Control Systems, Elsevier Publication,2007.
4. C.T.Chen Linear System Theory and Design, PHI, India.
5. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson2 Edu, India, 2009.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)

(16EC5501) MICROCONTROLLERS & INTERFACING

M.Tech I Year -I Sem. (CS)	**L**	**T**	**C**
	4	**-**	**4**

UNIT-I

INTEL 8051: Architecture of 8051, Memory Organization, Register banks, Bit addressing media, SFR area, Addressing modes, Instruction set, Programming examples, 8051 Interrupt structure, Timer modules, Serial Features, Port structure, Power saving modes.

UNIT-II

MOTOROLA 68HC11: Controllers features, Different modes of operation and memory map, Functions of I/O ports in single chip and expanded multiplexed mode, Timer system.

PIC MICROCONTROLLERS:

Program memory, CPU registers, Register file structure, Block diagram of PIC 16C74, I/O ports, Timer 0, 1 and 2 features, Interrupt logic, serial peripheral interface, I2C bus, ADC, UART PIC family parts.

UNIT-III

MICROCONTROLLER INTERFACING: 8051, 68HC11, PIC-16C6X and ATMEL External Memory Interfacing – Memory Management Unit, Instruction and data cache, memory Controller, On Chip Counters, Timers, Serial I/O, Interrupts and their use PWM, Watch dog, ISP, IAP features.

UNIT-IV

ARM PROCESSOR FUNDAMENTALS:

Registers, State and Instruction Sets, Pipeline, Memory Management, Introduction to the ARM Instruction Set.

UNIT-V

INTERRUPT SYNCHRONIZATION:

Interrupt vectors & priority, external interrupt design, Serial I/O Devices: RS232 Specifications, RS552/ Apple Talk/ RS 553/RS435 & other communication protocols, Serial Communication Controller.

CASE STUDIES:

Design of Embedded Systems using the micro controller 8051/ ARM6TDMI for applications in the area of Communications, Automotives, industrial control.

TEXT BOOKS:

1. The 8051 Micro Controller & Embedded Systems Pearson Education, Asia (2000),M.A. Mazadi & J.G. Mazidi.
2. Designing with PIC Micro Controllers Pearson Education, John B. Peatman,.
3. Embedded Microcomputer systems, Real Time Interfacing, Brookes/Cole, Thomas Learning, 1999Jonathan W. Valvano.
4. ARM Systems Developer’s Guides- Designing & Optimizing System Software–Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.

REFERENCES:

1. 8-bit Embedded Controllers, INTEL Corporation 1990.
2. Designing with PIC Microcontrollers, Pearson Education Inc, India, 2005.John B.Peatman,
3. Embedded Microcomputer Systems, Real Time Interfacing, Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.
4. Probability Methods of Signal and System Analysis. George R. Cooper, Clave D. MC Gillem, 3rd Edition, 1999, Oxford.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7502) DIGITAL CONTROL SYSTEMS

M.Tech I Year -I Sem. (CS)	L	T	C
	4	-	4

Unit I:
Introduction, Advantages of Digital control systems, Practical aspects of the choice of sampling rate and multirate sampling, 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:
Digital control systems, Pulse transfer function, z-transform analysis of open loop, closed loop systems, Modified z-Transform, transfer function, Stability of linear digital control systems, Stability tests, Root loci, Frequency domain analysis, Bode plots, Gain margin and phase margin , Design of Digital Control Systems based on Root Locus Technique.

Unit IV:
Cascade and feedback compensation by continuous data controllers, Digital controllers Design using bilinear transformation, Realization of Digital PID controllers. State equations of discrete data systems, solution of discrete state equations, State transition Matrix: z-transform method. Relation between state equations and transfer functions.

Unit V
Concepts on Controllability and Observability, Digital state observer: Design of the full order and reduced order state observer, Pole placement design by state feed back,
Design of Dead beat Controller, some case studies, Stability analysis of discrete time systems based on Lyapunov approach.

TEXT BOOKS:

1. K. Ogata, Discrete Time Control Systems, PHI/Addison, Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.

REFERENCES:

1. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison, Wesley Longman, Inc., Menlo Park, CA, 1998.
2. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India,1997.
3. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
4. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw,Hill, 1st edition
5. Bernard Fried Land, Control System Design, Mc. Graw,Hill, 1st edition
6. Dorsay, Continuous and Discrete Control Systems, McGraw, Hill.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7503)SOFT COMPUTING TECHNIQUES

M.Tech I Year -I Sem. (CS)	L	T	C
	4	-	4

UNIT- I:

FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS

Neural networks, introduction, artificial neural network, advantages, biological neural network, architectures of artificial neural networks, activation functions, important terminologies of ANN, Mcculloch, pitts-neuron model, learning strategies, supervised, Unsupervised, reinforced, learning rules, Hebbian learning rule, Perceptron learning rule, delta learning rule, widrow hoff learning rule, correlation learning rule, winner take all learning rule, out star learning rule, concept of linear separability with AND & XOR examples.

UNIT-II:

SUPERVISED, UNSUPERVISED NETWORKS & ASSOCIATIVE MEMORIES

Supervised networks: back propagation neural network architecture, training algorithm, learning factors, initial weights, steepness of the activation function, leaning constant, momentum method and necessary number of hidden neurons, Unsupervised networks: Kohonen selforganizing map, competitive process, cooperation process, adaptive process, training algorithm, Counter propagation Networks, full counter propagation network, architecture, training algorithm, Associative memories: concepts, Bidirectional Associative Memory (BAM), architecture, discrete BAM, testing algorithm, analysis of hamming distance, energy function and storage capacity, Discrete Hopfield network architecture and training algorithm, Applications of artificial neural networks,short term electrical load forecasting, process identification, Applications of neural networks to control systems

UNIT-III:

CLASSICAL AND FUZZY SETS

Introduction, classical sets, operations, properties, Fuzzy sets, operations, properties, Crisp relations, cardinality operations, properties, Cartesian product, composition, Fuzzy relations, cardinality, operations, properties, fuzzy cartesian product, composition, Linguistic hedges, membership functions, features, methods of membership value assignments, intuition, inference, rank ordering, neural networks, inductive reasoning.

UNIT-IV:

FUZZY LOGIC SYSTEMS

Defuzzification: Lamda, cuts for fuzzy sets and fuzzy relations, defuzzification methods, max membership principle, weighted average, centroid, center of sums, Fuzzy rule base, formation of rules, decomposition of rules, aggregation of rules, design procedure, Applications of fuzzy logic, speed control of a dc motor, air conditioner control, Example of fuzzy logic control for any one industrial application.

UNIT-V:

GENETIC ALGORITHM

Introduction to evolutionary computing, GA, biological back ground of GA, terminologies and operators of GA, search space, individuals, genes, fitness function, population, encoding, binary encoding, breading, selection, roulette wheel, rank selection, tournament, crossover, single point and two point crossovers, mutation, flipping, interchanging, reversing, Probabilities of cross over & mutation. Replacement, random, weak parent replacement, Termination criteria, flow chart, advantages, limitations and applications, Applications of genetic algorithms to control systems.

TEXT BOOKS:

1. S.N. Sivanandam, S.N. Deepa, Principles of Soft computing, Wiley India private Ltd., 2nd Edition, 2013.
2. Timothy J Ross, Fuzzy Logic with Engineering Application, McGraw Hill Inc.1997.

REFERENCES:

1. Jacek M. Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House.
2. Simon Haykin, Neural Networks - A Comprehensive Foundation, Prentice- Hall Inc, 1999.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7504) ROBOT MODELING AND CONTROL
(Elective-I)

	L	T	C
M.Tech I Year -I Sem. (CS)	**4**	**-**	**4**

UNIT I:

Spatial Descriptions and Transformations

Introduction, Descriptions: positions, orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: translations, rotations, transformations, Transformation arithmetic, Transform equations, More on representation of orientation, Transformation of free vectors, Computational considerations.

Manipulator Kinematics

Introduction, Link description, Link connection description, convention for affixing frames to links, Manipulator kinematics, Actuator space, Joint space and Cartesian space, Examples: Kinematics of two industrial robots, Computational considerations.

UNIT II:

Inverse Manipulator Kinematics

Introduction, Solvability, The notation of manipulator sub-space when n<6, Algebraic Vs Geometric, Algebraic solution by reduction to polynomial, Pieper's solution when three axes intersect, Examples of inverse manipulator kinematics, The standard frames, Solving a manipulator, Repeatability and accuracy, Computational considerations.

UNIT III:

Jacobians: Velocities and Static Forces

Introduction, Notation for time varying position and orientation, Linear and Rotation of velocity of rigid bodies, More on angular velocity, Motion of the links of a Robot, Velocity "propagation" from link to link, Jacobians, Singularities, Static forces in Manipulators, Jacobians in the force domain, Cartesian transformation of velocities and static forces.

Manipulator Dynamics

Introduction, Acceleration of a rigid body, Mass distribution, Newton's Equation, Euler's equation, Iterative Newton – Euler dynamic formulation, Iterative Vs Closed form, An example of closed form dynamic equations, The structure of the Manipulator dynamic equations, Lagrangian Formulation of manipulator Dynamics, Formulating manipulator dynamics in Cartesian space, Computational considerations.

UNIT IV:

Linear Control of Manipulators

Introduction, Feedback and closed loop control, Second order linear systems, Control of second order systems, Control law partitioning, Trajectory, Following control, Disturbance rejection, Continuous Vs Discrete time control, Modeling and control of a single joint, Architecture of industrial robot controller.

Non-Linear Control of Manipulators

Introduction, Nonlinear and time, varying systems, multi-input-Multi-output control systems,The control problem for manipulators Practical considerations, Present industrial robot control systems, Lyapunov stability analysis, Cartesian based control systems, adaptive control.

UNIT V:

Force Control of Manipulator

Introduction, Application of Industrial robots to assembly tasks, A frame work for control in partially constrained tasks, The hybrid position/force control problem, Force control of a mass, spring, The hybrid position / force control scheme, Present industrial robot control scheme.

TEXT BOOKS:

1. J. J. Craig, Introduction to Robotics, Addison Wesley, 1986
2. Mark W. Sponge, Sethhutchinson and M. Vidyasagar Robot Modeling and Control, Wiley student Edition, 2006.

REFERENCES:

1. Tsuneo Yoshikawa, Foundations of Robotics –Analysis and Control, Eatern economy Edition, 1990
2. Znihua Qu and Drasen M Dawson, Robust Tracking Control of Robot Manipulators, EEE Press, 1996.
3. J. J. Craig, Adaptive Control of Mechanical Manipulators, Addison Wesley, Reading MA, 1988.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7505) ADVANCED INSTRUMENTATION SYSTEMS
(Elective-I)

M.Tech I Year -I Sem. (CS)	L	T	C
	4	-	4

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, Thermoelectric Transducers, Piezo-electric phenomenon, Piezo-electric materials, Piezo-electrictorque Transducers, Piezo-electric Acceleration transducers, Magnetostrictive phenomenon, Magnetostrictive Acceleration transducers, Hall effect Transducers, Tachometers, variable reluctance tachometers, Electromagnetic Flow meter, Photoelectric phenomenon, photoconductive Transducers, photovoltaic Transducers, Photoemissive Transducers, Ionization vacuum gauges, Ionization displacement Transducers, Digital displacement Transducers, Digital Tachometers, Electromechanical Transducers.

UNIT III:

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 IV:

Signals and their representation Laplace and Fourier Transforms, standard test signals, Periodic signals, apreiodicsignals, bandwidth, modulated signals, sampled data pulse modulation, Data Acquisition Systems, General configurations, single and multi channel DAS, A/D converters (successiveapproximation and dual slope integration), sample and hold circuits, Anti alia filters, multiplexers and demultiplexers, Digital multiplexers.

UNIT V:

Data Transmission and Telemetry Characteristics of a Telemetry system, landline telemetry, radio telemetry, frequency division multiplexing, time division multiplexing, 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.

Text Books:

1. D.V.S.Murthy, Transducers & Instrumentation; Prentice Hall of India Pvt. Ltd., Firstedition, 1995
2. C. S. Rangan, G. R. Sarma, V. S. V. Mani, Instrumentation Devices & Systems, TMH, 2nd edition, 2003

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE4301) PRINCIPLES OF MACHINE MODELING AND ANALYSIS
(Elective-II)

M.Tech I Year -I Sem. (CS)	L	T	C
	4	-	4

UNIT-I

Basic Principles for Machine Analysis:
Magnetically coupled circuits, Machine windings and air gap MMF, winding inductances and voltage equations.

Modeling and Analysis of DC Machines:
Elementary dc machine, voltage and torque equations, types of dc machines, permanent magnet and shunt dc motors, time-domain and state equations.

UNIT-II

Reference Frame Theory:
Introduction to transformations, equations of transformations, change of variables and transformation to an arbitrary reference frame, commonly used reference frames, transformation between reference frames, Steady state phasor relationships and voltage equations.

UNIT-III

Modeling of Three Phase Induction Machines: Voltage and torque equations in machine variables, Voltage and torque equations in arbitrary reference frame, Steady-state analysis and its operation.

Dynamic analysis of three,phase Induction Machine:
Free acceleration characteristics viewed from various reference frames, dynamic performance during sudden changes in load torque, dynamic performance during a three-phase fault at the machine terminals.

UNIT-IV

Modeling of Synchronous Machine:
Voltage and torque equations in machine variables,Voltage equations in arbitrary and rotor reference frame, torque equations in substitute variable, Steady-state analysis and its operation.

Dynamic Analysis of Synchronous Machine:
Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

UNIT-V

Modeling of Single Phase Induction Machine:
Comparison between single phase and poly phase induction motor, Cross field theory of Single-phase induction machine, steady state analysis, steady state torque.

TEXT BOOKS:

1. Krause, Wasynczuk, Sudhoff, Analysis of Electric Machinery and Drive Systems:2nd Edition, Wiley Interscience Publications, 2002.
2. P. C. Krause, Analysis of Electric Machinery.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7506) SENSORS AND SIGNAL CONDITIONING
(Elective-II)

M.Tech I Year -I Sem. (CS)	**L**	**T**	**C**
	4	**-**	**4**

UNIT-I

INTRODUCTION TO MEASUREMENT SYSTEMS:

General concepts and terminology, Measurement systems, sensor classification, general input, output configuration, methods of correction, Performance characteristics**:** static characteristics of measurementsystems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors and random errors, dynamic characteristics of measurement systems: zero order, first order, and second order measurement systems and response.

UNIT-II

RESISTIVE SENSORS:

Potentiometers, strain gages and types, resistive temperature detectors (RTDS), thermistors, magneto resistors, light, dependent resistors (LDRS).

SIGNAL CONDITIONING FOR RESISTIVE SENSORS:

Measurement of resistance, voltage dividers, Wheatstone bridge, Balance and deflection measurements, sensor bridge calibration and compensation instrumentation amplifiers, interference types and reduction.

UNIT-III

REACTANCE VARIATION AND ELECTROMAGNETIC SENSORS:

Capacitive sensors, variable & differential, inductive sensors, reluctance variation, eddy current, linear variable differential transformers (LVDT's), variable transformers: synchros, resolvers, inductosyn, magneto elastic sensors, electromagnetic sensors, sensors based on faraday's law, hall effect sensors.

SIGNAL CONDITIONING FOR REACTANCE VARIATION SENSORS:

Problems and alternatives, ac bridges, carrier amplifiers,application to the LVDT, variable oscillators, resolver to digital and digital to resolver converters.

UNI- IV

SELF-GENERATING SENSORS:

Thermo electric sensors, piezo electric sensors, pyro electric sensors, photo voltaic sensors, electrochemical sensors.

SIGNAL CONDITIONING FOR SELF GENERATING SENSORS:

Chopper and low, drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT-V

DIGITAL SENSORS:

Position encoders, variable frequency sensors, quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions, thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge coupled sensors, types of ccd imaging sensors, ultrasonic based sensors, fiberoptic sensors.

TEXT BOOK:

1. Sensors and Signal Conditioning: Ramon Pallás Areny, John G. Webster, 2nd edition, John Wiley and Sons, 2000.
2. Sensors and Transducers, D. Patranabis, TMH 2003.

REFERENCES:

1. Sensor Technology Handbook, Jon Wilson, 2004.
2. Instrument Transducers, an Introduction to Their Performanceand Design, by Herman K.P. Neubrat, Oxford University Press.
3. Measurement System: Applications and Design, by E.O. Doeblin, McGraw Hill Publications.
4. Process Control Instrumentation Technology, D. Johnson, JohnWiley and Sons.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)

(16EE7507) CONTROL SYSTEM LAB

M.Tech I Year -I Sem. (CS)	**L**	**P**	**C**
	0	**4**	**2**

List of Experiments

1. Determination of Transfer functions of an Electrical System.
2. Time Response Characteristics of a Second order System (Typical RLC network).
3. Characteristics of Synchros:
   (a) Synchro transmitter characteristics.
   (b) Implementation of error detector using synchro pair.
4. Determination of Magnetic Amplifier Characteristics with different possible connections.
5. Process Control Simulator:
   (a) To determine the time constant and transfer function of first order process.
   (b) To determine the time response of closed loop second order process with Proportional Control.
   (c) To determine the time response of closed loop second order process with Proportional,Integral Control.
   (d) To determine the time response of closed loop second order process with Proportional,Integral,Derivative Control.
   (e) To determine the effect of disturbances on a process.
6. To study the compensation of the second order process by using:
   (a) Lead Compensator.
   (b) Lag Compensator.
   (c) Lead, Lag Compensator
7. Realization of AND, OR, NOT gates, other derived gates and ladder logic on Programmable Logic Controller with computer interfacing.
8. To determination of AC servomotor Characteristics.
9. To study the position control of DC servomotor with P, PI control actions.
10. Analog Computer:
    (a) To examine the operation of potentiometer and adder.
    (b) To examine the operation of integrator.To solve a second order differential equation.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7508) PROCESS DYNAMICS AND CONTROL

M.Tech I Year -II Sem. (CS)

L	T	C
4	-	4

Unit I:

Introduction to Process Control, Illustrative Example, Classification of Control Strategies, Process Control and Block Diagrams, Control and Modeling Philosophies, Dynamic versus Steady state Models, General Modeling Principles, Models of Several Representative Processes, Solution of Dynamic Models and the Use of Digital Simulators.

Unit II:

Development of a Transfer Function, Linearization of Nonlinear Models, Response of Integrating Process Units, Poles and Zeros and their Effect on System response, Time Delays, Approximation of Higher, Order Systems, Interacting and Non interacting Processes, Transfer function Models for Distributed Systems, Multiple-Input-Multiple-Output (MIMO) Processes. Feedback Controllers, Stirred, Tank Heater Example, Controllers, Digital Versions of PID Controllers, Transducers and Transmitters, Final Control Elements, Accuracy in Instrumentation.

Unit III:

Block Diagram Representation, Closed- Loop Transfer functions, Closed- Loop Responses of Simple Control Systems, General Stability Criterion, Routh- Stability Criterion for time delay systems, Direct Substitution method, Root Locus Diagrams. Performance Criteria for Closed-Loop Systems, Direct Synthesis Method, Internal Model Control, Design Relations for PID Controllers, Comparison of Controller Design Relations.

Unit IV:

Guidelines for Common Control Loops, Trail and Error Tuning, Continuous Cycling Method, Process Reaction Curve Method, troubleshooting Control Loops, Introduction to Feed forward Control, Ratio Control, Feed forward Controller Designbased on Steady, State Models, Controller Design based on Dynamic Models, Tuning Feed forward Controllers, Configurations for Feed forward, Feedback Control.

Unit V:

Process Interactions and Control Loop Interactions, Pairing of Controlled and Manipulated Variables, Strategies for Reducing Control Loop Interactions, Decoupling Control Systems, Multivariable Control Techniques.

TEXT BOOKS:

1. Dale E. Seborg, University of California, Santa Barbara, Thomas F. Edgar, University of Texas at Austin, Duncan A. Mellichamp, University of California, Santa Barbara, Process Dynamics and Control, John Wiley & Sons, 1989.
2. Dale E. Seborg, University of California, Santa Barbara, Thomas F. Edgar, University ofTexas at Austin, Duncan A. Mellichamp, University of California, Santa Barbara, ProcessDynamics and Control, John Wiley & Sons, 2nd Edition, 2004.

REFERENCES:

1. Brian Roffel, Ben Betlem, Process Dynamics and Control Modeling for Control and Prediction, John Wiley & Sons Ltd., 2007.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7509) NONLINEAR CONTROL THEORY

M.Tech I Year -II Sem. (CS)

L	T	C
4	-	4

UNIT-I

Linear versus nonlinear systems, Describing function analysis: Fundamentals, common nonlinearities (saturation, dead zone, on-off non linearity, backlash, hysteresis) and their describing functions, Describing function analysis of nonlinear systems, Reliability of describing method analysis, Compensation and design of nonlinear system using describing function method.

UNIT-II

Phase plane analysis, Phase portraits, Singular points characterization, Analysis of non-linear systems using phase plane technique, Existence of limit cycles, Linearization, Exact linearization, input state linearization, input-output linearization.

UNIT-III

Concept of stability, stability in the sense of Lyapunov and absolute stability, Zero input and BIBO stability, Second (or direct) method of Lyapunov stability theory for continuous and discrete time systems. Aizerman's and Kalman's conjecture, Construction of Lyapunov funtion, Methods of Aizerman, Zubov, Variable gradient method, Lure problem.

UNIT-IV

Popov's stability criterion, generalized circle criterion, Kalman, Yakubovich, Popov Lemma, Popov's hyperstability theorem.

UNIT-V

Concept of variable, structure controller and sliding control, reaching condition and reaching mode, implementation of switching control laws, Reduction of chattering in sliding and steady state mode, Some design examples of nonlinear systems such as the ball and beam, flight control, magnetic levitation and robotic manipulator etc.

TEXT BOOKS:

1. J. E. Slotine and Weiping LI, Applied Nonlinear Control, Prentice Hall,
2. Hassan K. Khalil, Nonlinear Systems, Prentice Hall, 1996.

REFERENCES:

1. Sankar Sastry, Nonlinear Systems Analysis, Stability and Control.
2. M.Vidyasagar, Nonlinear Systems Analysis, Prentice, Hall International editions,1993.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7510) OPTIMAL CONTROL THEORY

M.Tech I Year -II Sem. (CS)	L	T	C
	4	-	4

UNIT-I

An overview of optimization problem, concepts and terms related to optimization, constrained and unconstrained problems and their solutions using different techniques, Convex set and convex function, convex optimization problem, quadratic optimization problem, Karush, Kuhn, Tucker (KKT) necessary and sufficient conditions for quadratic programming problem.

UNIT-II

Interior point method for convex optimization, linear programming, primal and dual problems and basic concept of multi, objective optimization problem, Concept of functional, different types of performance indices, Euler, Lagrange equation.

UNIT-III

Calculus of variation to optimal control problem, Fundamental concepts, functionals of a single function, functional involving several independent functions, necessary conditions for optimal control, linear regulator problems.

UNIT-IV

Linear quadractic regulator, remarks on weighting matrices, solution of Riccati equation, Frequency domain interpretation of linear quadratic regulator, robustness studies.

UNIT-V

Dynamic programming, Pontrygin's minimum principle, time optimal control, concept of system and signal norms, statement of problem and its solution.

TEXT BOOKS:

1. Jasbir S. Arora, Introduction to optimum design, Elesevier, 2005.
2. A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, Engineering optimization : Methods and applications, Wiley India Edition.
3. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice, Hall Network series, First edition, 1970.

REFERENCES:

1. D.S. Naidu, Optimal control systems, CRC Press, First edition, 2002.
2. Arturo Locatelli, Optimal control: An Introduction, Birkhauser Verlag, 2001.
3. S.H.Zak, Systems and Controll, Indian Edition, Oxford University, 2003.
4. Niclas Anreasson, Anton Evgrafov and Michael Patriksson, An introduction to continuous optimization, Overseas Press (India) Pvt. Ltd.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)

(16EE7511) ADVANCED DIGITAL SIGNAL PROCESSING

M.Tech I Year -II Sem. (CS)	L	T	C
	4	-	4

UNIT-I

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms, Discrete time signals and systems, Discrete time Fourier transform, its properties and applications, Fast Fourier Transform (in time domain and Frequency domain), IDFT and its properties.

UNIT-II

z-Transform: Definition and properties, Rational z-transforms, Region of convergence of a rational z-Transform, The inverse z-Transform, z-Transform properties, Computation of the convolution sum of finite, length sequences, The transfer function.

UNIT-III

Digital filter structures: Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT-IV

IIR Digital filter design: Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

FIR digital filter design: Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT-V

Analysis of Finite word length effects: The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms.The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

TEXT BOOKS

1. Digital Signal Processing, S.K. Mitra, Tata McGraw,Hill, Third Edition, 2006.
2. Principle of Signal Processing and Linear Systems, B.P. Lathi, Oxford International Student Version, 2009
3. Continuous and Discrete Time Signals and Systems, M. Mondal and A Asif, Cambridge, 2007

REFERENCES

1. Digital Signal Processing, Fundamentals and Applications,LiTan-Indian reprint, Elsevier,2008.
2. Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald, W. Schafer, and John R.Buck, Pearson Education, 2008.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7512) ADAPTIVE LEARNING AND CONTROL
(Elective-III)

M.Tech I Year -II Sem. (CS)	L	T	C
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Unit-I

Introduction, use of Adaptive control, definitions, essential aspects, classification, Model Reference Adaptive Systems, different configurations, classification, mathematical description, Equivalent representation as a nonlinear time varying system, direct and indirect MRAC.

Unit-II

Continuous time MRAC systems, Model Reference Adaptive System Design based on Gradient method, Design of stable adaptive controllers based on Kalman, Meyer, Yakubovich Lemma, Lyapunov theory, Hyper stability theory, Narendra's error model approach.

Unit-III

Discrete time MRAC systems, Hyper stability approach, Narendra's error model approach, Introduction, stability theorem, Relation to other algorithms, hybrid adaptive control, Self Tuning Regulators (STR), different approaches to self tuning, Recursive parameter estimation, implicit STR, Explicit STR.

Unit-IV

STR design based on pole, placement technique and LQG theory, Gain scheduling, Stability of adaptive control algorithms, Adaptive control of a nonlinear systems, Adaptive predictive control, Robustness of adaptive control systems, Instability phenomena in adaptive systems.

Unit-V

Concept of learning control systems, Different types of learning control schemes, LTI learning control via parameter estimation schemes, Convergence of learning control, Case Studies: Robotic manipulators, Aerodynamic curve identification, Electric drives,Satellite altitude control.

Text books

1. K.J.Astrom and Bjorn Wittenmark, Adaptive control, Pearson Edu., 2nd Edn.
2. Sankar Sastry, Adaptive control.

References

1. V.V.Chalam, Adaptive Control System, Techniques & Applications, Marcel DekkerInc.
2. Miskhin and Braun, Adaptive control systems, MC Graw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7513) ROBUST CONTROL
(Elective-III)

M.Tech I Year -II Sem. (CS)	L	T	C
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UNIT-I

Review of classical feedback control

Review of classical feedback control: The control problem, Transfer functions, Derivinglinear models, Frequency response, Feedback control, Closed loop stability, Evaluating closed loop performance, Controller design, Loop shaping, Shaping closed loop transferfunctions.

UNIT-II

Introduction to Multivariable Control

Transfer functions for MIMO systems, Multivariable frequency response analysis, Controlof multivariable plants, Introduction to robustness, General control problem formulation.

Elements of Linear System Theory

Internal stability of feedback systems, Stabilizing controllers, System norms, Input-Output Controllability, perfect control and plant inversion, Constraints on S and T.

UNIT-III

Limitations on Performance in SISO Systems

Limitations imposed by RHP, zeros Limitations imposed by RHP poles, Performance requirements imposed by disturbances and commands, Limitations imposed by input constraints, Limitations imposed by uncertainty.

Limitations on Performance in MIMO Systems

Constraints on S and T, Functional Controllability, Limitations imposed by RHP, zeros, Limitations imposed by RHP, poles, Performance requirements imposed by disturbances, Limitations imposed by input constraints, Limitations imposed by uncertainty.

UNIT-VI

Uncertainty and Robustness for SISO Systems

Introduction to robustness, Representing uncertainty, parametric uncertainty, Representing uncertainty in the frequency domain, SISO robust stability, SISO robust performance,Examples of parametric uncertainty.

UNIT-V

Robust Stability and Performance Analysis

General control formulation with uncertainty, Representing uncertainty, Obtaining P, N and M, Definition of robust stability and performance, Robust stability of the $M\Delta$, structure, RS for complex unstructured uncertainty, RS with structured uncertainty: Motivation, The structured singular value and RS, Properties and computation of μ,Robust performance, Application: RP with input uncertainty, μ-synthesis and DK iteration, Further remarks on μ.

Control System Design

Trade offs in MIMO feedback design, LQG control, H_2 and H_{∞} control, H_{∞} loop shaping design.

TEXT BOOKS:

1. Sigurd Skogestad and Ian Postlethwaite, Multivariable Feedback Control Analysis and Design, John Wiley & Sons Ltd., 2nd Edition, 2005.
2. D. W. Gu, P. Hr. Petkov and M. M. Konstantinov "Robust Control Design with MATLAB" Spring, Verlag London Ltd., 2005.

REFERENCES:

1. Kennin Zhou, "Robust and Optimal Control", Prentice Hall, Engle wood Cliffs, New Jersy.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7514) POWER PLANT INSTRUMENTATION
(Elective-IV)

M.Tech I Year -II Sem. (CS)

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UNIT-I

AN OVERVIEW OF POWER GENERATION

Brief survey of methods of power generation, Hydrothermal, Nuclear, Solar, Wind etc. Importance of instrumentation for power generation, Thermal power plants, Building blocks, Details of the Boiler Processes, PI diagram of Boiler, Cogeneration.

PARAMETERS AND MEASUREMENTS

Electrical measurements, current, Voltage, Power, Frequency powerfactor, Trivector meter.
Non electrical parameters, flow of feed water, fuel, air and steam with correction factors for temperature, Pressure, temperature, level radiation detectors, smoke density measurements, dust monitor.

UNIT-II

COMBUSTION CONTROL IN BOILERS

Combustion control, control of Main header Pressure, air fuel ratio control, furnace draft and excessive air control, drum level (three element control) main and reheat steam temperature control, burnertilting up, bypass damper, super heater.

OTHER CONTROLS

Spray and gas recirculation controls, BFP recirculation control, Hot well and deaerator level control, pulverizer control, Computers in Power Plants.

UNIT-III

TURBINE MONITORING AND CONTROL

Condenser vacuum control, gland steam exhaust pressure control, Speed, vibration, Shell temperature monitoring and control, Lubricating oil temperature control, Hydrogen, generator coolingsystem.

UNIT-lV

ANALYZERS IN POWER PLANTS

Thermal conductive type, paramagnetic type, Oxygen analyzer, infrared type and trim analyzer, Spectrum analyzer, hydrogen purity meter, Chromatography, PH meter, Conductivity cell, fuel analyzer, brief survey of pollution monitoring and control equipment.

UNIT-V

ANALYZERS IN POWER PLANTS

Thermal conductive type, paramagnetic type, Oxygen analyzer, infrared type and trim analyzer, Spectrum analyzer, hydrogen puritymeter. Chromatography, PH meter, Conductivity cell, fuel analyzer, brief survey of pollutionmonitoring and control equipment.

TEXT BOOKS:

1. Modern Power Stations Practice, vol. 6, Instrumentation, Controls and Testing Pergamon Press, Oxford, 1971.
2. Power Plant Technology, by Wakil M.M., McGraw Hill.

REFERENCES:

1. Standard Boiler Operations, Questions and Answers, by Elonka S.M. and Kohal A.L., TMH, New Delhi, 1994.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7515) INDUSTRIAL INSTRUMENTATION
(Elective-IV)

M.Tech I Year -II Sem. (CS)	**L**	**T**	**C**
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UNIT-I

PRESSURE AND TEMPERATURE MEASUREMENT

Vacuum and low pressure measurement using Monometer, McLeod Gage, Knudsen Gage, Ionization Gases, Thermal conductivity, Pressure measurement using bourdon gages, capsule gages, bellows,pressure transmitter, dead weight tester, force balance, vibration cylinder, dual gage techniques, and calibration,Temperature standards, fixed points, filled system ermometers, bimetallic thermometer, types of thermocouple, laws of thermocouples, cold junction compensation, RTD, 2wire,3wire, 4wire connections,thermistor and linearization, IC sensors, optical and radiation pyrometers, calibration.

UNIT-II

FLOW AND LEVEL MEASUREMENT

Solid flow measurement, Flow equation, flow measurement in pipelines, liquid and gas rotameter, head type, positive displacement, vortex type, hotwire anemometer, electromagnetic type, ultrasonic type, laser Doppler velocimeter, mass flow meter, gas flow meter, selection criteria, calibration, Solid level measurement, visual technique, float operated devices, displacer devices, pressure gage method, diaphragm type, differential pressure method, boiler drum level, electrical methods, conductive sensor, capacitive sensor, ultrasonic type, purging techniques.

UNIT- III

FORCE AND TORQUE MEASUREMENT

Force measurement, different methods, gyroscopic method, vibrating wire sensor, strain gage type,calibration, Definition of torque, different methods, dynamometer, gyroscope, calibration.

UNIT-IV

VELOCITY AND ACCELERATION MEASUREMENT

Relative velocity, translational and rotational velocity measurement, velocity of rotating machinery, speed measurement using tachometer, electrical and magnetic types, revolution counter, proximity type, photo electric type, stroboscope, Acceleration, accelerometer, different types, measurement in rotating machinery, calibration.

UNIT-V

OTHER MEASUREMENTS

Nuclear radiation fundamentals, radiation detector, sound level meter, microphone, hydrophone, humidity and moisture measurement, overview of density measurement, measurement of chemical composition, smoke measurement, pollution measurement, clean room and measurement of particles.

TEXT BOOKS:

1.Measurement systems,Application and Design, by Doeblin, 4/e, McGraw Hill nternational, 1990.

2. Mechanical measurements by A.K Shawney, Khanna publishers.

3. Instrumentation by C.S.Rangan, Mani and Sharma, Tata McGraw Hill publishing.

REFERENCES:

1.Process Instruments and Control Handbook by D.M Considine, 4/e, McGraw Hill International, 1993.

2. Mechanical and Industrial Measurements by R.K.Jain, Khanna Publishers,

3. Instrument Technology, vol,1 by E.B.Jones, Butterworths, 1981.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
(16EE7516) ADVANCED CONTROL SYSTEMS LAB

M.Tech I Year -II Sem. (CS)	L	P	C
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List of Experiments

The following experiments may be implemented in MATLAB/SIMULINK environment.

1. Preliminary Transformations:
   (a) Transfer function to State space models vice, versa.
   (b) Conversion of Continuous to Discrete time systems vice, versa.
   (c) Verification of controllability and observablity of a given system.
2. Design of state feedback controllers.
3. Stability analysis of a given system using:
   (a) Root Locus.
   (b) Bode plot.
   (c) Lyapunov stability.
4. Implementation of Kalman Filter.
5. Implementation of Least squares error method.
6. Implementation of PID controller and its effects on a given system.
7. Design of Lead, Lag, Lead, Lag compensators using frequency domain analysis.
8. Construction of Simulink model for an Induction motor.

Note: At least four problems may be implemented from the following

9. Solving steady state Ricatti Equation.
10. Construction of Simulink model foe single area and multi area Power system.
11. Solving an optimal control problem using Ricatti equation.
12. Implementation of Full order and minimum order Observer.
13. Implementation of Back,Propagation Algorithm.
14. Implementation of simple Fuzzy controller.
15. Implementation of storage and recall algorithm of Hopfield network model.