JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech. (CONTROL ENGINEERING/ CONTROL SYSTEMS)
EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Modern Control Theory	25	75	4	0	0	4
PC-2	Digital Control Systems	25	75	4	0	0	4
PC-3	Estimation of Signals and Systems.	25	75	4	0	0	4
PE-1	1. Intelligent Control 2. System Dynamics and Control 3. Process Modelling and Simulation	25	75	3	0	0	3
PE-2	1. Instrumentation and Control 2. Advanced Microprocessors 3. DSP Processor Architecture and Applications	25	75	3	0	0	3
OE-1	***Open Elective – I**	25	75	3	0	0	3
Laboratory I	Control System Engineering lab-I	25	75	0	0	3	2
Seminar I	Seminar -I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Optimal Control Theory	25	75	4	0	0	4
PC-5	Adaptive and Learning Control	25	75	4	0	0	4
PC-6	Embedded Systems and Control	25	75	4	0	0	4
PE-3	1. Programmable Logic Controllers and Applications 2. Non-linear Systems 3. Robust Control	25	75	3	0	0	3
PE4	1. Advanced Digital Signal Processing 2. Real Time Systems 3. Robotics and Control	25	75	3	0	0	3
OE-2	***Open Elective - II**	25	75	3	0	0	3
Laboratory II	Control System Engineering lab-II	25	75	0	0	3	2
Seminar II	Seminar -II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
Total	**100**	**100**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

MODERN CONTROL THEORY
(Professional Core -I)

Prerequisite: Control Systems
Course Objectives:

- To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes: Upon completion of this course, students should be able to:

- Various terms of basic and modern control system for the real time analysis and design of control systems.
- To perform state variables analysis for any real time system.
- Apply the concept of optimal control to any system.
- Able to examine a system for its stability, controllability, and observability.
- Implement basic principles and techniques in designing linear control systems.
- Formulate and solve deterministic optimal control problems in terms of performance indices.
- Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT I:
Mathematical Preliminaries and State Variable Analysis: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT II:
Controllability and Observability: General concept of controllability – Controllability tests, different state transformations such as diagnolization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

UNIT III:
State Feedback Controllers and Observers: State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

UNIT IV:
Non-Linear Systems: Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane

analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT V:

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory by – New Age International - 1984
2. Ogata. K, Modern Control Engineering by– Prentice Hall - 1997
3. N K Sinha, Control Systems– New Age International – 3rd edition.

REFERENCES:

1. Donald E. Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series - First edition.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

DIGITAL CONTROL SYSTEMS
(Professional Core –II)

Course Objectives:

- To explain basic and digital control system for the real time analysis and design of control systems.
- To apply the knowledge state variable analysis in the design of discrete systems.
- To explain the concept of stability analysis and design of discrete time systems.

Course Outcomes: Upon the completion of this course, the student will be able to

- Apply the concepts of Digital control systems.
- Analyze and design of discrete systems in state variable analysis.
- To relate the concepts of stability analysis and design of discrete time systems.

UNIT – I:

Concept & Representation of Discrete time Systems: Block Diagram of typical control system-advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals.

Z-transform: Definition of Z-transforms – mapping between s-plane and z-plane – inverse z-transform – properties of z-transforms - ROC of z-transforms –pulse transfer function –relation between G(s) and G(z) – signal flow graph method applied to digital control systems.

UNIT- II:

State Space Analysis: : State space modeling of discrete time systems – state transition equation of discrete time invariant systems – solution of time invariant discrete state equations: recursive method and the Z-Transformation method – conversion of pulse transfer function to the state model & vice-versa – Eigen values – Eigen vectors of discrete time system-matrix (A) – Realization of pulse transformation in state space form, discretization of continuous time systems, Computation of state transition matrix and its properties. Response of sample data system between sampling instants.

UNIT – III:

Controllability, Observability & Stability tests: Concept of controllability, stabilizability, observability and reachability - Controllability and observability tests, Transformation of discrete time systems into controllable and observable forms.

Stability: Definition of stability – stability tests – The second method of Liapunov.

UNIT- IV:

Design of discrete time Controllers and observers: Design of discrete time controller with bilinear transformation – Realization of digital PID controller-Design of deadbeat controller; Pole placement through state feedback.

UNIT-V:

STATE OBSERVERS: Design of - Full order and reduced order observers. Study of observer based control design

TEXT BOOKS:

1. K. Ogata, Discrete-Time Control systems, Pearson Education/PHI, 2nd Edition.
2. V. I. George, C. P. Kurian, Digital Control Systems, Cengage Learning.

3. M. Gopal, Digital Control Engineering, New Age Int. Pvt. Ltd., 2014

REFERENCES:

1. Kuo, Digital Control Systems, Oxford University Press, 2nd Edition, 2003.
2. M. Gopal , Digital Control and State Variable Methods, TMH.
3. M. Sami Fadali Antonio Visioli, Digital Control Engineering Analysis and Design, Academic Press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

ESTIMATION OF SIGNAL AND SYSTEMS
(Professional Core – III)

Course Objectives:

- To expose students to different system identification concepts.
- To make the use of random-process models to represent non-deterministic signals and noise
- To extract the time-domain and frequency-domain structure of the signals and noise from the models

Course Outcomes: Upon the completion of this course, the student will be able to

- Apply the concepts of developing mathematical models for industrial systems,
- Develop models from first principles and data driven models.

UNIT I:
Review of Probability theory and random variable - random process - Linear Regression. ARMAX Model Structure.

UNIT II:
Concept of estimation, Recursive least squares (RLS), Consistency of estimation, Weighted LS. Convergence analysis LS. Parametric models - LS estimation, bias - Generalized Least Squares (GLS)

UNIT III:
Parameters estimation using Instrumental Variable (IV) method. Persistently exciting input signal - Likelihood functions and Maximum Likelihood Estimation (MLE) - Singular Value Decomposition (SVD).

UNIT IV:
Kalman filter, State estimation using Kalman filter, Parameter estimation using Kalman filter.

UNIT V:
Extended Kalman Filters (EKF), State and Parameter estimations of nonlinear systems using EKF.

TEXT BOOKS:

1. Papoulis and Pillai, Probability, Random Variables and Stochastic Process, McGraw Hill, 2002.
2. Jerry M. Mendel, Lessons in Estimation Theory for Signal Processing, Communications, and Control, Prentice - Hall, 1995.

REFERENCES:

1. Karl J Astrom, Introduction to Stochastic Control Theory, Mathematics in Series and Engg., Vol. 70.
2. Michel Verhaegen and Vincent Verdult, Filtering and System Identification A Least Squares Approach, Cambridge Univ. Press, 2007.
3. M.S. Grewal and A. P. Andrews, Kalman Filtering Theory and Practice Using Matlab, John Wiley, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

INTELLIGENT CONTROL
(Professional Elective-I)

Course Objectives:

- Gaining an understanding of the functional operation of a variety of intelligent control techniques and their bio-foundations
- the study of control-theoretic foundations
- learning analytical approaches to study properties

Course Outcomes: Upon the completion of this course, the student will be able to

- Develop Neural Networks, Fuzzy Logic, and Genetic algorithms.
- Implement soft computing to solve real-world problems mainly pertaining to control system applications

Unit-I

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

Unit-II

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feedforward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis.

Unit-III

Networks: Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems.

Unit-IV

Genetic Algorithm: 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 ant-colony search techniques for solving optimization problems.

Unit-V

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. Fuzzy logic control for nonlinear time-delay system. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TEXT BOOKS:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J. Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms.

4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.

REFERENCES:

1. M.T. Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M. Ham and Ivica Kostanic, Principles of Neuro computing for science and Engineering, McGraw Hill, 2001.
3. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms, and Applications, Mc - Graw Hill, Inc. 1996.
4. Yung C. Shin and Chengying Xu, Intelligent System - Modeling, Optimization and Control, CRC Press, 2009.
5. N. K. Sinha and Madan M Gupta, Soft computing & Intelligent Systems - Theory & Applications, Indian Edition, Elsevier, 2007.
6. Witold Pedrycz, Fuzzy Control and Fuzzy Systems, Overseas Press, Indian Edition, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

SYSTEM DYNAMICS AND CONTROL
(Professional Elective - I)

Course Objectives:

- To learn about dynamic behavior of nonlinear, distributed and other complex systems,
- To design the various controllers based on Dynamic Models.

Course Outcomes: Upon the completion of this course, the student will be able to

- After the completion of this course the student will be able to get the Knowledge of phase plane, Laplace domain, and frequency domain analysis of nonlinear distributed and multivariable systems for dynamic behavior and stability.
- Able to design various controllers.
- Analyze systems for advanced control strategies.

UNIT-I:
Concepts of dynamic and static systems, Physical models and system construction, Electrical behavior components, Concept of energetic systems ,Electromechanical systems, Hybrid and integrated system examples, Degrees of freedom analysis, 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.

UNIT-III:
Feedback Controllers Stirred - Tank Heater Example, Controllers, and Digital Versions of PID Controllers, Transducers and Transmitters, Final Control Elements, Accuracy in Instrumentation.
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.

UNIT-IV:
Performance Criteria for Closed - Loop Systems, Direct Synthesis Method, Internal Model Control, Design Relations for PID Controllers, Comparison of Controller Design Relations.
Guidelines for Common Control Loops, Trail and Error Tuning, Continuous Cycling Method, Process Reaction Curve Method, troubleshooting Control Loops.

UNIT-V:
Introduction to feed forward Control, Ratio Control, and Feed forward Controller Design based on Steady - State Models, Controller Design based on Dynamic Models, Tuning Feed forward Controllers, Realization of microcomputer control systems, interfacing with external equipment, computer data acquisition, and control, illustration of a computer implementation: preliminaries, microcomputer realization of a liquid level/flow control system.

TEXT BOOKS:

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 2^{nd} Edition, 2004.
2. System dynamics and control, Eronini Umez-Eronini, Published by PWS pub. Co. 1999

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

PROCESS MODELING AND SIMULATION
(Professional Elective - I)

Course Objectives:
- To understand the concepts of process model and control
- to enable to develop model and simulation of process control

Course Outcomes: After the completion of this course, the student will be able to
- understand the fundamentals and overview of process control, the static and Dynamic analysis of instrumentation system,
- apply the concept of Simulation and Modeling,
- able to develop Advanced Control Schemes for real time applications
- Able to Design Multi-loop Controllers and Digital controllers.
- Analyze Real Time Control strategies.

UNIT- I:
Introduction to Modelling: Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.

UNIT-II:
Steady State and Dynamic Models of Process Systems-I: Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems.

UNIT–III:
Steady State and Dynamic Models of Process Systems-II: Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

UNIT-IV:
Solution Strategies for Lumped Parameter Models: Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method, shooting method, finite difference methods. Solving the problems using relevant softwares.

UNIT-V:
Solution Strategies for Distributed Parameter Models: Solution strategies for distributed parameter models. Solving parabolic, elliptic, and hyperbolic partial differential equations. Finite element and finite volume methods.

TEXT BOOK:

1. K. M. Hangos and I. T. Cameron, "Process Modeling and Model Analysis", Academic Press, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

INSTRUMENTATION AND CONTROL
(Professional Elective – II)

Course Objectives:

- To provide knowledge of Instrumentation systems and their applications.
- To provide knowledge of advanced control theory and its applications to engineering problems.
- To have a comprehensive idea about P, PI, PD, PID controllers

Course Outcomes: Upon the completion of this course, the student will be able to

- To understand and analyze instrumentation systems and their applications to various industries.
- To apply advanced control theory to practical engineering problems.

Unit-I

Instrumentation: Introduction to mechanical systems and their structure and function, Performance Characteristics – Static and Dynamic, Fundamentals of signals acquisition, conditioning and processing,

Unit-II

Measurement of temperature, pressure, flow, position, velocity, acceleration, force, torque etc.

Unit-III

Control: Introduction to control systems, mathematical model of physical systems in transfer function and state space forms, response of dynamic systems, concept of pole & zero of a system,

Unit-IV

Realization of transfer functions, stability analysis. Introduction of discrete time system. Controllers: P, PI, PD, PID, Feed forward etc., tuning of controller parameters, disturbance rejection, implementation of controller using digital computer.

Unit-V

Control components: Actuator (ac & dc servomotors, valve), AC, DC tacho-generators, servo amplifier.

TEXT BOOKS:

1. John P Bently, “Principles of Measurement Systems” 3rd. Edition, Pearson
2. Alok Barua, “Fundamentals of Industrial Instrumentation’ Wiely India, 2011
3. William Bolton, “Instrumentation and Control Systems”, Elsevier, 2015

REFERENCES:

1. William Bolton, “Industrial Control and Instrumentation” University Press, 1991
2. Norman A Anderson,” Instrumentation for Process Measurement and Control” CRC, 1997
3. K. Ghosh, “Introduction to Instrumentation and Control” Prentice Hall of India, 2005

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

ADVANCED MICROPROCESSORS
(Professional Elective - II)

Prerequisite: Microprocessor and its applications
Course Objectives:
- To understand architectural features of 8086 microprocessors
- to understand various peripheral devices and different components interfacing with it along with 8051 microcontroller
- To understand architectural features of advanced processors and microcontrollers
- To learns necessary programming skills to develop applications.

Course Outcomes: After completion of this course the student
- Develops knowledge and skills for programming of 8086 microprocessors and interfacing techniques for various peripheral devices.
- Attains programming skills of 8051 microcontrollers and its applications through various case studies.

UNIT-I:
Intel 8086/8088: Architecture, its register organization, pin diagram, minimum and maximum mode system and timings, machine language instruction formats, addressing modes, instruction set, assembler directives and operators.

UNIT-II:
ALP AND Special Architecture Features: ALP, Programming with an assembler, stack structure, interrupts, and service subroutines and interrupt programming and Macros.

UNIT-III:
Multiprocessor Systems: Inter connection topologies, numeric processor 8087, I/O processor 8089. Bus arbitration and control design of PC based multiprocessor systems, virtual memory, paging, segmentation.

UNIT-IV:
Advanced Processors: Architectural features of 80836,486 and Pentium processors their memory management, introduction to Pentium pro processors their features, RISC Vs CISC processors, RISC properties, evaluation, architectural features of DEC alpha AXP, power PC family, and sun SPARC family systems.

UNIT-V:
Microcontroller: Microcontrollers – 8051 architectures, hardware, interrupts, addressing modes, instruction set –programming-applications.

TEXT BOOKS:

1. BARRY B. Brey, Intel microprocessors, architecture, programming and interfacing 8086/8088, 80186,80836 and 80846-.PHI-5th edition-2001
2. TABAK, Advanced microprocessors -McGraw-Hill Inc 2nd edition.
3. A. K. Ray and K M Bhurchandani, Advanced microprocessors and peripherals, TMH
4. Nilesh B. Bahadure, Microprocessors, PHI Learning PVT. Ltd.

REFERENCES:

1. K.J. Ayala, 8051 microcontroller – architecture programming & applications, Penram Intl.
2. Myke Pretko, Programming & customizing the 8051 microcontroller – TMH, 1st edition ,1999
3. W.A. Triebel &Avtar Singh, The 8088 and 8086 microprocessor -PHI, 4th edition 2002.
4. N. Senthil, Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, Microprocessors, and Interfacing, Oxford University press.
5. N. Mathivanan, Microprocessors, PC Hardware and Interfacing, PHI Learning PVT. Ltd.
6. Krishna Kant, Microprocessors and Microcontrollers, Architecture, Programming and System Design, PHI Learning PVT. Ltd.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

DSP PROCESSOR ARCHITECTURE AND APPLICATIONS
(Professional Elective - II)

Prerequisite: Microprocessor and its applications

Course Objectives:

- To introduce various techniques of digital signal processing that are fundamental to various industrial applications.
- To learn the basis of DSP systems, its theory and practical implementation of different kind of algorithms
- To know third generation DSP architectures and interfacing of memory and I/O peripherals to the DSP processors.

Course Outcomes: After completion of this course the student

- Gets an in depth knowledge of DSP processors their architectures.
- Knows programming language techniques, integration of DSP programmable devices with memories and I/O peripherals.

UNIT-I:

Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT),Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB,DSP using ATLAB. **Computational Accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT-II:

Architectures for Programmable DSP Devices: Basic Architectural features, DSP computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed issues Features for External interfacing.
EXECUTION CONTROL AND PIPELINING: Hardware looping, Interrupts, Stacks, Relative Branch Support, Pipelining and performance, Pipeline Depth, Interlocking, Branching effects, interrupt effects, pipeline Programming models.

UNIT-III:

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT-IV:

Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, PID Controller, Adaptive Filters, 2-D Signal Processing. Implementation of FFT Algorithms: An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit reversed index generation, An 8-point FFT implementation on the TMS320C54XX, Computation of signal spectrum.

UNIT-V:

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, parallel I/O interface, Programmed I/O, Direct Memory access(DMA).A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

TEXT BOOKS:

1. S. Salivahanan, A. Vallavaraj. C. Gnanpriya, Digital signal processing -TMH-2nd, 2001.
2. Lourens R Rebinarand Bernold, Theory, and applications of digital signal processing.
3. Auntoniam, Digital filter analysis and design -TMH.

REFERENCE BOOKS:

1. Sanjit K. Mitra, Digital signal processing - TMH second edition
2. Lan V. Opphenheim, Ronald W. Shafer, Discrete time signal processing -PHI 1996 1st edition.
3. John G. Proakis, Digital signal processing principles – algorithms and applications -PHI-3rd edition 2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Control Engg. / Control Sys.)

CONTROL SYSTEM ENGINEERING LAB-I

Course Objectives:

- To acquire knowledge on control aspects of an electrical system.
- To become familiar with the use of simulation tools for the purpose of modeling, analysis and design of systems

Course Outcomes: Student will be able to

- Represent various discrete time systems
- Analyze the given system by Transfer function and state space approach using suitable software.
- Design various controllers and compensators to improve system performance and test them in the laboratory as well as using suitable software.
- To model a given system and its stability Analysis

List of Experiments:

1. Development of schematic Model of a dynamical system (Motor/Generator/ Power System etc)
2. Obtain the dynamic response of a continuous system and comment on the effect of parameter variations.
3. Time-Domain Analysis, Error–Analysis, Stability Analysis in Continuous and Discrete domains.
4. Stability Analysis (Bode, Root Locus, Nyquist) Of Linear Time Invariant System in discrete domain
5. Evaluation Of The Effect Of Additional Poles And Zeroes On Time Response Of Second Order System and its stability
6. Design of Digital controllers (P, PI, PID Controllers)
7. Design of Digital Compensators.
8. Design of State Feedback Controllers and Observers
9. Conversion of State Space Model into Classical Transfer Function and Vice Versa.
10. Simulation Of A Closed Loop System(Plant And Compensator) for discrete systems
11. Obtain the phase portraits for non linear system represented by $\dot{x} = f(x)$ and comment on the aspects of stability for various initial conditions on phase plane.
12. Obtain the describing function for a given nonlinearity over the different sets of range amplitudes for a fixed frequency.
13. Obtain the limit cycle time response and phase plot for stable and unstable vanderpol's equation
14. Estimation of parameters Using Recursive Least Squares Estimator.
15. For a given discrete plant representation in state space. Design a Kalman filter and time varying (extended) kalman filter to estimate the output y based on the noisy measurements:
16. Based on the distribution of means from repeated random samples of an exponential distribution, with specified Population parameter, Sample size, number of samples.
17. Visualize the distribution of sample means together with the fitted normal distribution

Note: The above problems are to be illustrated by considering a suitable system, and by using suitable software or hardware.

Note: Minimum of Ten experiments out of which six experiments related to core courses are to be conducted.