**R19 COURSE STRUCTURE AND SYLLABUS**

**I YEAR I – SEMESTER**

<table>
<thead>
<tr>
<th>Course Code</th>
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*For Dissertation Work Review - I, Please refer 7.8 in R19 Academic Regulations.

**Audit Course I & II:**

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by yoga
8. Personality Development Through Life Enlightenment Skills
MODERN CONTROL THEORY (Professional Core - I)

Prerequisite: Control Systems

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

Course Outcomes: Upon completion of this course, students should be able to:
1. Various terms of basic and modern control system for the real time analysis and design of control systems.
2. To perform state variables analysis for any real time system.
3. Apply the concept of optimal control to any system.
4. Able to examine a system for its stability, controllability, and observability.
5. Implement basic principles and techniques in designing linear control systems.
6. Formulate and solve deterministic optimal control problems in terms of performance indices.
7. Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT - I:

UNIT - II:
Controllability and Observability: General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordan 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:
UNIT - V:
**Stability Analysis:** Stability in the sense of Lyapunov, Lyapunov’s stability, and Lyapunov’s instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasoviski’s method.

**TEXT BOOKS:**
1. M. Gopal, Modern Control System Theory by – New Age International - 1984

**REFERENCES:**
Course Objectives:
1. To expose students to different system identification concepts.
2. To make the use of random-process models to represent non-deterministic signals and noise.
3. 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:
1. Apply the concepts of developing mathematical models for industrial systems,
2. Develop models from first principles and data driven models.

UNIT - I:

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:

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

TEXT BOOKS:

REFERENCES:
INTELLIGENT CONTROL (Professional Elective - I)

Course Objectives:
1. Gaining an understanding of the functional operation of a variety of intelligent control techniques and their bio-foundations
2. the study of control-theoretic foundations
3. learning analytical approaches to study properties

Course Outcomes: Upon the completion of this course, the student will be able to
1. Develop Neural Networks, Fuzzy Logic, and Genetic algorithms.
2. Implement soft computing to solve real-world problems mainly pertaining to control system applications

UNIT - I

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

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

TEXT BOOKS:
REFERENCES:
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

SYSTEM DYNAMICS AND CONTROL (Professional Elective - I)

Course Objectives:
1. To learn about dynamic behavior of nonlinear, distributed and other complex systems,
2. To design the various controllers based on Dynamic Models.

Course Outcomes: Upon the completion of this course, the student will be able to
1. 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.
2. Able to design various controllers.
3. 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:

UNIT- III:

UNIT- IV:

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:
2. System dynamics and control, Eronini Umez-Eronini, Published by PWS pub. Co. 1999
REFERENCE BOOK:
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

PROCESS MODELING AND SIMULATION (Professional Elective - I)

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

Course Outcomes: After the completion of this course, the student will be able to
1. Understand the fundamentals and overview of process control, the static and Dynamic analysis of instrumentation system,
2. Apply the concept of Simulation and Modeling,
3. Able to develop Advanced Control Schemes for real time applications
4. Able to Design Multi-loop Controllers and Digital controllers.
5. 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:

UNIT-IV:

UNIT-V:

TEXT BOOK:
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Control Engineering. / Control System.)

INSTRUMENTATION AND CONTROL (Professional Elective – II)

Course Objectives:
1. To provide knowledge of Instrumentation systems and their applications.
2. To provide knowledge of advanced control theory and its applications to engineering problems.
3. 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
1. To understand and analyze instrumentation systems and their applications to various industries.
2. 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

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

TEXT BOOKS:

REFERENCES:
ADVANCED MICROPROCESSORS (Professional Elective - II)

Prerequisite: Microprocessor and its applications

Course Objectives:
1. To understand architectural features of 8086 microprocessors
2. To understand various peripheral devices and different components interfacing with it along with 8051 Microcontroller
3. To understand architectural features of advanced processors and microcontrollers
4. To learns necessary programming skills to develop applications.

Course Outcomes: After completion of this course the student
1. Develops knowledge and skills for programming of 8086 microprocessors and interfacing techniques for various peripheral devices.
2. 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:

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
3. A. K. Ray and K M Bhurchandani, Advanced microprocessors and peripherals, TMH
4. Nilesh B. Bahadure, Microprocessors, PHI Learning PVT. Ltd.

REFERENCES:
5. N. Mathivanan, Microprocessors, PC Hardware and Interfacing, 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:
1. To introduce various techniques of digital signal processing that are fundamental to various industrial applications.
2. To learn the basis of DSP systems, its theory and practical implementation of different kind of algorithms
3. 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
1. Gets an in-depth knowledge of DSP processors their architectures.
2. Knows programming language techniques, integration of DSP programmable devices with memories and I/O peripherals.

UNIT- I:

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:
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:
2. Lourens R Rebinar and Bernold, Theory, and applications of digital signal processing.
3. Auntoniam, Digital filter analysis and design -TMH.

REFERENCE BOOKS:
RESEARCH METHODOLOGY AND IPR

Prerequisite: None

Course Objectives:
- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to
- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:
Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:

UNIT-V:
TEXT BOOKS:
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

REFERENCES:
Course Objectives:
1. To acquire knowledge on control aspects of an electrical system.
2. 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
1. Represent various discrete time systems
2. Analyze the given system by Transfer function and state space approach using suitable software.
3. Design various controllers and compensators to improve system performance and test them in the laboratory as well as using suitable software.
4. 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
6. Design of Digital controllers (P, PI, PID Controllers)
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
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.
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Control Engg. / Control Sys.)

MODELING AND SIMULATION LAB – I (Lab – II)

WRITING PROGRAMS AND DEMONSTRATION
1. Declination of earth, hour angle, day length, local apparent time
3. Power generation from a wind turbine, Variation of wind velocity and power with altitude
4. Solution of ordinary differential equations-4th order R K Method
5. Solution of one-dimensional steady state heat conduction equation
6. Solution of two-dimensional steady state PDE
7. Solution of one-dimensional transient PDE

FINITE ELEMENT ANALYSIS
8. Two-dimensional heat conduction
9. One dimensional transient heat conduction
10. Transient analysis of a casting process

CFD ANALYSIS
11. Flow through a pipe bend
12. Flow through a nozzle
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Control Engg. / Control Sys.)

ADAPTIVE CONTROL (Professional Core – III)

Prerequisite: Control Systems

Course Objectives:
1. To present an overview of theoretical and practical aspects of adaptive control
2. To understand and apply adaptive controls in practical and industrial control systems.

Course Outcomes: After completion of this course, the student should be able to:
1. Design and implement system identification experiments
2. Utilize input-output experimental data for identification of mathematical dynamical models.
3. Design adaptive controls using system identification methods

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

UNIT - III
Self Tuning Regulators (STR) - different approaches to self tuning - Recursive parameter estimation - implicit STR - Explicit STR. STR design based on pole - placement technique and LQG theory.

UNIT - IV
Adaptive control of 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.

TEXT BOOKS:
2. Sankar Sastry, “Adaptive control”.

REFERENCES:
1. V. V. Chalam, “Adaptive Control System - Techniques & Applications”, Marcel Dekker Inc.
OPTIMAL CONTROL THEORY (Professional Core - IV)

Prerequisite: Control Systems

Course Objectives:
1. To provide a basic knowledge of the theoretical foundations of optimal control
2. To develop skills needed to design controllers using available optimal control theory and software
3. To implement optimization methods for optimal control.

Course Outcomes: After the completion of this course, the student will be able to
1. Understand the design and implement system identification experiments
2. Apply input-output experimental data for identification of mathematical dynamical models.
3. Apply singular value techniques to analyze the robustness of control systems.
4. Incorporate frequency-domain-based specifications into multivariable control system designs.
5. Apply H-infinity methods to design controllers

UNIT - I:
Static optimization: An overview of optimization problem - concepts and terms related to optimization - constrained and unconstrained problems and their solutions using different techniques; such as Gradient method, steepest and decent method, conjugate gradient method and Newton's method

UNIT - II:

UNIT - III:
Primal and dual optimization problem: Interior point method for convex optimization - linear programming - primal and dual problems and basic concept of multi-objective optimization problem

UNIT - IV:
Dynamic Optimization: Concept of functional, different types of performance indices, Calculus of variation to optimal control problem - Fundamental concepts of functional involving a single and multiple independent functions, necessary and sufficient conditions for optimal solution of problem

UNIT V:
Formulation of optimal regulator control problem: State the linear quadratic regulator problem and derive the solution of optimal regulator control problem; remarks on weighting matrices, solution of Riccati equation by iterative method and eigen-value and eigen vector methods.

TEXT BOOKS:
REFERENCES:
Prerequisite: No Prerequisite

Course Objectives:
1. It is to provide and ensure a comprehensive understanding of using advanced controllers in measurement and control instrumentation.
2. To illustrate about data acquisition - process of collecting information from field instruments.
3. To analyze Programmable Logic Controller (PLC), IO Modules and internal features.
4. To Comprehend Programming in Ladder Logic, addressing of IO.
5. To apply PID and its Tuning.

Course Outcomes:
1. Describe the main functional units in a PLC and be able to explain how they interact.
2. They should know different bus types used in automation industries.
3. Development of ladder logic programming for simple process.
4. At the end of each chapter, review question, problems given to reinforce their understanding of the concepts.

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.
Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT- III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT- IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT- V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing, analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TEXT BOOKS:

REFERENCE BOOKS:
Course Objectives:
1. To provide various methods of analysis and design of nonlinear control systems.
2. To introduce nonlinear deterministic dynamical systems, and their applications to nonlinear circuits and control systems.

Course Outcomes: Upon the completion of this course, the student will be able to
1. Know control systems of practical importance are inherently nonlinear,
2. Analyze nonlinear systems and controllers.
3. Apply various stability criteria to control systems

UNIT - I:

UNIT - II:
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 - III:

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,

REFERENCES:
Prerequisite: Control Systems

Course Objectives:
1. To understand the concepts of optimal and robust control,
2. To enable to analyze and design a robust Control System.

Course Outcomes: Upon the completion of this course, the student will be able to
1. Have knowledge on Parametric Optimization
2. Acquire knowledge of Calculus of variations, Pontryegans Max/min Principle, learn Dynamic Programming in Continuous and Discrete Time
3. Apply iterative methods of optimization,
4. Analyze and design a robust Control System.

UNIT - I
Overview and Preliminaries: Overview on Robust control, Basics from Matrix Algebra, Norms of signals and systems (L_2, H_2, L_\infty, H_{\infty}). Convex Optimization: Convexity, Convex sets, Affine function, Linear matrix inequality (LMI), Projection lemma, S-procedure, Semi-definite programming, Feasibility problem, Minimization problem, Generalized eigen value problem, Programming in MATLAB.

UNIT - II

UNIT - III

UNIT - IV
H\infty controller synthesis: Generalized H\infty controller synthesis problem, Controller design via LMI approach. H\infty Loopshaping Design: Four-block problem, Loopshaping concept, Weight selection, Controller synthesis via LMI.

UNIT - V

TEXT BOOKS:

REFERENCES:
Prerequisite: Digital signal processing

Course Objectives:
1. To emphasize the advanced concepts of digital signal processing and the mathematical basis of discrete time signal analysis.
2. To introduce the implementation of DSP algorithms and power spectrum analysis.

Course Outcomes: Upon the completion of this course, the students will be able to
1. Solve the various types of practical problems of DSP processors.
2. Develop DSP based real time systems.
3. Design and analyze various filters.

UNIT–I:

UNIT- II:

UNIT- III:

UNIT-IV:

UNIT-V:

TEXT BOOKS:
REFERENCES:
3. Auntoniam, Digital Filter Analysis and Design, TMH.
Course Objectives:

1. To introduce multi tasking techniques in real time systems
2. To introduce the theory of formal verification methods and techniques used for real time and hybrid systems.

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

1. Identify multi tasking techniques in real time systems
2. Evaluate the performance of soft and hard real time systems
3. Analyze multi task scheduling algorithms for periodic, aperiodic and sporadic tasks
4. Design real time operating systems and hybrid systems.
5. Know the methods and techniques used in industries for the verification of Real Time & Hybrid systems.

UNIT- I:

UNIT- II:
Hierarchical representation of complex DES. Input, Output and Communication. Examples of modeling practical systems as RT DES. Modeling programs as RTS. Analyzing RTS: Analyzing logical properties of DES such as Reachability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

UNIT - III:

UNIT - IV:
Real time System, Multi tasking, Static and Dynamical Scheduling of resource Allocation, Real-time Programming.

UNIT-V:
Real - time process and applications, Distributed Real - time systems.

TEXTBOOK:


REFERENCE:

ROBOTICS AND CONTROL (PE - IV)

Course Objectives:
1. To understand basic mathematics involved in the design of robotic manipulators, robotic configurations
2. To introduce necessary mathematical models to estimate position, velocity, and force required to operate these robotic manipulator.
3. To understand various robotic manipulators and the design criteria for linear and non-linear systems.

Course Outcomes: Upon the completion of this course, the student will be able to
1. Develop the skills of mathematics and modeling techniques for the design of position, velocity, acceleration, and force of robotic manipulators.
2. Design and analyze linear and non-linear control systems.

UNIT - I:

UNIT - II:
Manipulator Kinematics and Inverse 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 - 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.

UNIT - IV:
Manipulator Dynamics: The structure of the Manipulator dynamic equations, Lagrangian Formulation of manipulator Dynamics, Formulating manipulator dynamics in Cartesian space, Computational considerations: 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.

UNIT - V:
Non - Linear Control & Force 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. A frame work for force control of a spring mass systems.
TEXT BOOKS:

REFERENCES:
Course Objectives:
1. To acquire knowledge on control aspects of an electrical system.
2. To become familiar with the use of simulation tools for the purpose of modeling, analysis and design of systems

Course Outcomes: Upon the completion of this course, the student will be able to
1. Represent various discrete time systems
2. Analyze the given system by Transfer function and state space approach using suitable software.
3. Design various controllers and compensators to improve system performance and test them in the laboratory as well as using suitable software.
4. Model the given system and its stability Analysis

List of Experiments:
1. Illustrate the Effect of Feedback On Disturbance & Control System design
2. Obtain the realization of PID controller and verify the results through computer simulations.
3. Obtain the realization of classical compensators and verify the results through computer simulations.
4. Find a vector $x$ that is a local minimum to a scalar function $f(x)$ subject to constraints on the allowable $x$: $\min_{x} f(x)$ such that one or more of the following holds: $c(x) \leq 0$, $ceq(x) = 0$, $A \cdot x \leq b$, $Aeq \cdot x = beq$, $l \leq x \leq u$.
5. Minimize the integral subject to the fixed endpoint conditions (the constraint on the problem)
6. Find the minimal arc $y(x)$ that optimizes the given performance index, using fixed endpoint and variable end point conditions.

$$I = \int_{x_1}^{x_2} f(x, y, y') dx \quad y(x_1) = a \quad y(x_2) = b$$

7. Obtain the optimal control for finite state and infinite state regulator problem.
8. Implementation of Adaptive control based on MIT rule and Liapunov theory.
9. Consider the process $G(s) = \frac{1}{s^2 + 2s + a}$, where $a$ is an unknown parameter. Assume that the desired closed-loop system is $G_m(s) = \frac{s^2}{s^2 + 2s + w^2}$. Construct continuous and discrete-time indirect self tuning algorithms for the system.
10. Obtain the solution of finite time and infinite time state regulator problem.
11. Program to interface keypad with 89C51. Whenever a key is pressed, it should be displayed on LCD.
12. Program to interface seven segment display unit with 89C51.
13. Program to interface Stepper Motor with 89C51 to rotate the motor in clockwise and anticlockwise directions.
14. Generation of PWM Signal

Note: Minimum of Ten experiments out of which six experiments related to core courses are to be conducted.
PREAMBLE:
Control Systems simulation Lab consists of multiple workstations, each equipped with an oscilloscope, digital multi-meter, PID trainers, control system trainers and standalone inverted pendulum, ball and beam control, magnetic-levitation trainers. This lab also covers the industrial implementation of advanced control systems via different computer tools such as MATLAB and Simulink.

OBJECTIVE & RELEVANCE
The aim of this Control system laboratory is to provide sound knowledge in the basic concepts of linear control theory and design of control system, to understand the methods of representation of systems and getting their transfer function models, to provide adequate knowledge in the time response of systems and steady state error analysis, to give basic knowledge is obtaining the open loop and closed-loop frequency responses of systems and to understand the concept of stability of control system and methods of stability analysis. It helps the students to study the compensation design for a control system. This lab consist of DC, AC servomotor, synchros, DC position control, PID controller kit with temperature control, lead lag compensator kit, PLC kit, Stepper, process control simulator.

OUTCOMES:
- After the completion of this course student able solve the control system problems by using the programs through MATLAB.
- Determination of transfer function useful to design the systems.
- Introducing of MATLAB in control systems solutions

LIST OF EXPERIMENTS:
1. Pspice simulation of op-amp based integrator & differentiator circuits
2. Simulation of saw tooth wave and sine wave using MATLAB
3. Simulation of triangular wave and ramp wave using MATLAB
4. Unity and non-unity feedback system using MATLAB
5. Block diagram reduction technique using MATLAB
6. Simulation of P, PD, PI, PID controller
7. Simulation of dc motor characteristics using MATLAB
8. Simulation of poles and zeros of a transfer function
9. State model for classical transfer function & vice versa using MATLAB
10. Transfer function analysis of 3rd order using Simulink
11. Stability analysis using bode plot using MATLAB
12. Stability analysis using root locus using MATLAB
13. Stability analysis using Nyquist plot using MATLAB

TEXT BOOKS:

REFERENCE BOOKS:
DIGITAL CONTROL SYSTEMS (Professional Elective - V)

Course Objectives:
1. To explain basic and digital control system for the real time analysis and design of control systems.
2. To apply the knowledge state variable analysis in the design of discrete systems.
3. 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
1. Apply the concepts of Digital control systems.
2. Analyze and design of discrete systems in state variable analysis.
3. To relate the concepts of stability analysis and design of discrete time systems.

UNIT – I:

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:

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.

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:
REFERENCES:
2. M. Gopal, Digital Control and State Variable Methods, TMH.
EMBEDDED SYSTEMS AND CONTROL (Professional Elective - V)

Prerequisite: Microprocessors and Interfacing Devices

Course Objectives:
1. To Comprehend the general embedded system concepts, design of embedded hardware and software development tools
2. To explain the basics of real time operating and embedded systems
3. To describe key issues such as CPU scheduling, memory management, task synchronization, and file system in the context of real-time embedded systems.

Course Outcomes: Upon the completion of the subject, the student will be able to
1. Gain knowledge and skills necessary to design and develop embedded applications based on real time operating systems.
2. Analyze and design embedded systems and real time systems
3. Define the unique design problems and challenges of real time systems
4. Identify the unique characteristics of real time operating systems and evaluate the need for real time operating system
5. Explain the general structure of a real time system and understand and use RTOS to build an embedded real time system

UNIT – I
An Introduction To Embedded Systems: An Embedded system, processor in the system, other hardware units, software embedded into a system, exemplary embedded systems, embedded system – on – chip (SOC) and in VLSI circuit. Processor and memory organization – Structural Units in a Processor, Processor selection for an embedded system, memory devices, memory selection for an embedded system, allocation of memory to program cache and memory management links, segments and blocks and memory map of a system, DMA, interfacing processors, memories and Input Output Devices.

UNIT – II
Devices And Buses For Device Networks: I/O devices, timer and counting devices, serial communication using the “I2 C” CAN, profibus foundation field bus. and advanced I/O buses between the network multiple devices, host systems or computer parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X and advanced buses.

UNIT - III
Device Drivers And Interrupts Servicing Mechanism: Device drivers, parallel port and serial port device drivers in a system, device drivers for internal programmable timing devices, interrupt servicing mechanism

UNIT – IV
Programming Concepts And Embedded Programming In C, C++, Vc++ And Java: Inter process communication and synchronization of processes, task and threads, multiple processes in an application, problem of sharing data by multiple tasks and routines, inter process communication.

UNIT - V:
Hardware: software co-design in an embedded system, embedded system project management, embedded system design and co-design issues in system development process, design cycle in the
development phase for an embedded system, use of target systems, use of software tools for development of an embedded system, use of scopes and logic analysis for system, hardware tests. Issues in embedded system design.

TEXTBOOKS
1. Embedded systems: Architecture, programming and design by Rajkamal, TMH
2. Embedded system design by Arnold S Burger, CMP

REFERENCES
1. An embedded software primer by David Simon, PEA
2. Embedded systems design: Real world design be Steve Heath; Butterworth Heinenann, Newton mass USA 2002
3. Data communication by Hayt.
SCADA SYSTEMS AND APPLICATIONS (Professional Elective - V)

Prerequisite: None

Course Objectives:
1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

Course Outcomes: After taking this course, student will be able to:
1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT-I:
Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA

UNIT-II:
Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT-III:
SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture –IEC 61850.

UNIT-IV:
SCADA Communication: various industrial communication technologies-wired and wireless methods and fiber optics. open standard communication protocols.

UNIT-V:
SCADA Applications: Utility applications- Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises

TEXT BOOKS:
REFERENCES:
ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

TEXT BOOKS/ REFERENCES:
Prerequisite: None

Course Objectives: Students will be able to
- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:
Introduction:
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-II:
Repercussions of Disasters and Hazards:

UNIT-III:
Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV:
Risk Assessment Disaster Risk:

UNIT-V:
Disaster Mitigation:
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.
TEXT BOOKS/ REFERENCES:
2. Sahni, Pardeep Et. Al. (Eds.),“ Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi.
SAKARALAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering) / Control System

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to
- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to
- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

UNIT-II:

UNIT-III:
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

UNIT-V:

TEXT BOOKS/REFERENCES:
CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:


UNIT-II:


UNIT-III:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

UNIT-IV:


UNIT-V:

TEXT BOOKS/ REFERENCES:
1. The Constitution of India, 1950 (Bare Act), Government Publication.
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:
- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

UNIT-II:
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:
Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT-IV:
Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:
Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

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Stress Management by Yoga (Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:
Definitions of Eight parts of yoga. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do’s and Don’t’s in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

Text Books/ References:
1. "Yogic Asanas for Group Training-Part-I"; Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:
Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:
Neetisatakam-Holistic development of personality
- Verses- 52,53,59 (don’ts)
- Verses- 71,73,75,78 (do’s)

UNIT-III:
Approach to day to day work and duties.
- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:
Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:
1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.