JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. CONTROL SYSTEMS/CONTROL ENGINEERING
EFFECTIVE FROM ACADEMIC YEAR 2019- 20 ADMITTED BATCH

R19 COURSE STRUCTURE AND SYLLABUS

I YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Modern Control Theory	3	0	0	3
Professional Core - II	Estimation of Signals & systems	3	0	0	3
Professional Elective - I	1. Intelligent Control 2. System Dynamics and Control 3. Process modeling and simulation	3	0	0	3
Professional Elective - II	1. Instrumentation and Control 2. Advanced Microprocessors 3. DSP processor architecture and Applications	3	0	0	3
	Research Methodology & IPR	2	0	0	2
Lab - I	Control System Engineering Lab - I	0	0	4	2
Lab - II	Modeling and Simulation Lab - I	0	0	4	2
Audit - I	Audit Course - I	2	0	0	0
	Total	**16**	**0**	**6**	**18**

I YEAR II – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - III	Adaptive Control	3	0	0	3
Professional Core - IV	Optimal Control Theory	3	0	0	3
Professional Elective - III	1. Programmable Logic Controllers and Applications 2. Non-linear Systems 3. Robust Control	3	0	0	3
Professional Elective - IV	1. Advanced Digital Signal Processing 2. Real time Systems 3. Robotics & Control	3	0	0	3
	Mini project with Seminar	0	0	4	2
Lab - III	Control System Engineering Lab - II	0	0	4	2
Lab - IV	Modeling and Simulation Lab - II	0	0	4	2
Audit - II	Audit Course - II	2	0	0	0
	Total	**14**	**0**	**10**	**18**

II YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. Digital Control System 2. Embedded Systems and Control 3. SCADA Systems and Applications	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review - II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II - SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review - III	0	0	12	6
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

***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

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:

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:
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.)

ESTIMATION OF SIGNAL AND SYSTEMS (Professional Core – II)

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:

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:

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

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:

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:

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, 2nd 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:

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:

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:

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

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’ Wiley 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:

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:

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:

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:

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 Rebinar and 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 Engineering. / Control System.)

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:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

REFERENCES:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
7. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

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

CONTROL SYSTEM ENGINEERING LAB-I (Lab – I)

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
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.

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
2. Monthly average, hourly global and diffuse radiation on a horizontal surface and tilted surfaces.
3. Power generation from a wind turbine, Variation of wind velocity and power with altitude
4. Solution of ordinary differential eqations-4^{th} 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

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.

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:

1. K. J. Astrom and Bjorn Wittenmark, “Adaptive control”, Pearson Edu., 2nd Edition.
2. Sankar Sastry, “Adaptive control”.
3. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, Prentice Hall INC, 2012.

REFERENCES:

1. V. V. Chalam, “Adaptive Control System - Techniques & Applications”, Marcel Dekker Inc.
2. Miskhin and Braun, Adaptive control systems, McGraw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, “Adaptive Control, Filtering and Signal Processing”
4. G. C. Goodwin, “Adaptive control”.

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

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:
Convex optimization: Convex set and convex function - convex optimization problem - quadratic optimization problem - Karush - Kuhn - Tucker (KKT) necessary and sufficient conditions for quadratic optimization problem.

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:

1. Jasbir S. Arora, Introduction to optimum design, Elesevier, 2005.
2. D.S. Naidu, Optimal control systems, CRC Press, First edition, 2002.
3. Ravindran, K. M. Ragsdell, and G. V. Reklaitis, Engineering optimization: Methods and applications, Wiley India Edition.

REFERENCES:

1. Donald E. Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series - First edition, 1970.
2. Arturo Locatelli, Optimal control: An Introduction, Birkhauser Verlag, 2001.
3. S. H. Zak, Systems and Control, Indian Edition, Oxford University, 2003.
4. Niclas Anreasson, Anton Evgrafov and Michael Patriksson, An introduction to continuous optimization, Overseas Press (India) Pvt. Ltd.

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

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS (PE – III)

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 Tunning.

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:

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

2. Digital Design by Morris Mano, PHI, 3rd Edition 2006.

REFERENCE BOOKS:

1. Programmable logic Controllers, Frank D. Petruzella, 4th Edition, McGraw Hill Publishers.
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth & F.D Hackworth Jr. – Pearson, 2004.
3. Programmable logic controllers and their Engineering Applications, 2nd Edition, Alan J. Crispin.

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

NON-LINEAR SYSTEMS (PE - III)

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:

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 - 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:

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 function - 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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Control Engg. / Control Sys.)
ROBUST CONTROL (PE – III)

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_∞, H_∞). 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

System properties and stability: Well-posedness, Causality, Passivity, Bounded-realness, Positive-realness, Internal stability, Bounded-Input-Bounded-Output stability, Finite-gain stability.

UNIT - III

Robust performance and Linear Fractional Transformation: Robust performance and limitations due to physical constraints, Linear Fractional Transformation (LFT), Uncertainties, Riccati equation and inequality. Useful Lemmas and Theorems in Robust Control: KYP Lemma, Bounded-real lemma, Positive-real lemma, Small-gain theorem, Passivity theorem.

UNIT - IV

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

UNIT - V

Mu Analysis and Synthesis: Robust stability and performance problems, structured singular value, D-scaling problem, D-K Iteration.

TEXT BOOKS:

1. Da-Wei Gu Petko Petkov, Mihali M Konstantinov, Robust Control Design with MATLAB, Springer – 2013.
2. Sigurd Skogestad, Ian Postlethwaite, Multivariable Feedback Control: Analysis and Design, John Wiley, 2005.
3. Kemin Zhou, John Constock Doyle, Kith Glovr, Robust and Optimal Control, PH Inc., 1996

REFERENCES:

1. Michael Green, David J.N. Limebeer, Linear Robust Control, PH Inc., 1995.
2. Uwe Mackenroth, Robust Control Systems: Theory and Case Studies, Springer, 2013.
3. S.O. Reza Moheimani, Perspective in Robust Control, Sprinter, 2001.

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

ADVANCED DIGITAL SIGNAL PROCESSING (PE – IV)

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:

Digital Filter Structures: Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures AII pass Filters - tunable IIR Digital Sine-cosine generator - Computational complexity of digital filter structures.

UNIT- II:

Digital Filter Design: Preliminary considerations- Bilinear transformation method of IIR filter design – design of Low pass high pass – Band pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design – based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.

UNIT- III:

DSP Algorithm Implementation: Computation of the discrete Fourier transform- Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

UNIT-IV:

Analysis of Finite Word Length Effects: The Quantization process and errors-Quantization of fixed –point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low – Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

UNIT-V:

Power Spectrum Estimation: Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

TEXT BOOKS:

1. Sanjit K. Mitra, Digital signal processing – TMH second edition
2. Alan V. Oppenheim, Ronald W, Shafer, Discrete Time Signal Processing – PHI 1996 1ST Edition reprint
3. John G. Proakis, Digital Signal Processing principles – Algorithms and Applications – PHI – 3RD edition 2002.

REFERENCES:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, Digital Signal Processing – TMH – 2nd reprint 2001.
2. Lourens R Rebinarand Bernold, Theory and Applications of Digital Signal Processing.
3. Auntoniam, Digital Filter Analysis and Design, TMH.

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

REAL TIME SYSTEMS (PE - IV)

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:

Introduction to Real-time systems: Typical examples of RTS, Characteristic features of RT applications. Structural, Functional and Performance requirement of Reactive RTS. Distinctive features from Non - RT and Off - line system. Modeling RTS: Representation of time, Concurrency and Distributedness in discrete event systems.

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:

Temporal logic, Model checking. Example of checking safety and timing properties of industrial systems. Requirements and features of real-time Computing Environments: Real-time Operating Systems, Interrupts, clock, Device support.

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:

1. Jane W S Liu, Real- Time Systems, Pearson Education, 1st edition.

REFERENCE:

1. Rajib Mall*, Real-Time Systems***:** Theory and Practice, Computer Science, Engineering and Computer Science, Higher Education, Pearson Education, *India***.**

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

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:

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.

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:

1. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Robot Modeling and Control, Wiley Publications, 2005.
2. J. J. Craig, 'Introduction to Robotics', Addison Wesley, 1986.
3. 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, IEEE Press, 1996.
3. J. J. Craig, Adaptive Control of Mechanical Manipulators, Addison Wesley, Reading MA, 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Control Engg. / Control Sys.)
CONTROL SYSTEM ENGINEERING LAB – II (Lab – III)

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: $c(x) \le 0$, $ceq(x) = 0$, $A \cdot x \le b$, $Aeq \cdot x = beq$, $l \le x \le u$.
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.

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

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$G(s) = \frac{1}{s(s+a)}$, where a is an unknown parameter. Assume that the desired closed-loop system is $G_m(s) = \frac{w^2}{s^2+2\xi ws+ w^2}$. 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 anti clockwise directions.
14. Generation of PWM Signal

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 – II Sem. (Control Engg. / Control Sys.)

MODELING AND SIMULATION LAB – II (Lab – IV)

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:
1. B. C. Kuo “Automatic Control Systems” 8th edition– by 2003– John Wiley and sons.
2. J. Nagrath and M. Gopal, “Control Systems Engineering” New Age International (P) Limited, Publishers, 2nd edition.

REFERENCE BOOKS:

1. Katsuhiko Ogata “Modern Control Engineering” Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
2. N. K. Sinha, “Control Systems” New Age International (P) Limited Publishers, 3rd Edition, 1998.
3. NISE “Control Systems Engg.” 5th Edition – John Wiley
4. Narciso F. Macia George J. Thaler, “Modeling & Control of Dynamic Systems” Thomson Publishers

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

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:

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 – II Year – I Sem. (Control Engineering. / Control System.)

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
4. 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.

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

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.
3. Knowledge about single unified standard architecture IEC 61850.
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:

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford, UK,2004.

REFERENCES:

1. William T. Shaw, “Cybersecurity for SCADA systems”, PennWell Books, 2006.
2. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes, 2003.
3. Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”, PennWell 1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

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:
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

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:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

DISASTER MANAGEMENT (Audit Course - I & II)

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

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:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

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:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.),” Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies”, Deep &Deep Publication Pvt. Ltd., New Delhi.

JAWAHARLAL 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
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

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:
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

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

UNIT-IV:
Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:
Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

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:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble**,** Salient Features.

UNIT-II:
Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

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:
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V:
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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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:
Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

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 scho 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:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

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 yog. (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 Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (Control Engineering. / Control System)

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 (dont's)
- 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.